INDUSTRIALIZED HOUSING: THE JAPANESE EXPERIENCE

DECEMBER 1985

Prepared By

JAMES McKELLAR

The views and conclusions expressed and the recommendations made in this report are entirely those of the authors and should not be construed as expressing the opinions of Alberta Municipal Affairs.

ISBN: 0-88654-123-9

FOREWORD

The project documented in this report received funding under the Innovative Housing Grants Program of the Alberta Department of Housing. In May, 1986 the Alberta Department of Housing was amalgamated with Alberta Municipal Affairs which is now responsible for issuing this report.

The Innovative Housing Grants Program is intended to encourage and assist housing research and development which will reduce housing costs, improve the quality and performance of dwelling units and subdivisions, or increase the long term viability and competitiveness of Alberta's housing industry.

The Program offers assistance to builders, developers, consulting firms, professionals, industry groups, building products manufacturers, municipal governments, educational institutions, non-profit groups and individuals. At this time, priority areas for investigation include building design, construction technology, energy conservation, site and subdivision design, site servicing technology, residential building product development or improvement and information technology.

As the type of project and level of resources vary from applicant to applicant, the resulting documents are also varied. Comments and suggestions on this report are welcome. Please send comments or requests for further information to:

Innovative Housing Grants Program
Alberta Municipal Affairs
10050 - 112 Street
Edmonton, Alberta
T5K 2J1

Telephone: (403) 427-8150

ACKNOWLEDGEMENTS

This work was undertaken with the assistance of research grants from the Research and Development Branch, Alberta Department of Housing, and the External Research Program, Canada Mortgage and Housing Corporation. The research was facilitated by a six-month sabbatical leave from the Faculty of Environmental Design, University of Calgary, and an invitation extended by the Laboratory of Architecture and Planning, Massachusetts Institute of Technology, to serve as a Visiting Scholar at MIT during this sabbatical leave period. Both the Canadian Embassy in Tokyo and the Government of Alberta, Tokyo Office, were of immeasurable assistance in completing the field work in Japan. Also, the excellent resources found throughout Cambridge, Massachusetts, made it possible to complete the necessary groundwork prior to travelling in Japan.

I am grateful to Dean Detomasi at the Faculty of Environmental Design for his continued support of my many and diverse ventures. Linden Holmen and Rex Adam at the Alberta Department of Housing and Chris Terry at Canada Mortgage and Housing Corporation maintained an active interest in this work and further bolstered my enthusiasm as the research progressed. At MIT, Professor Gary Hack, Chairman of the Department of Urban Studies and Planning, and Professor Michael Joroff, Director of the Laboratory of Architecture and Planning, made sure that the work would have continuing importance to the housing industry. Mention must be made of Nick Yazaki, Commercial Officer at the Canadian Embassy in Tokyo, and Hirokatsu Ogasawara, Commercial Officer in the Tokyo Office of the Government of Alberta, both of whom took it upon themselves to ensure the success of my itinerary while I was in Japan. Shelagh Deck typed the manuscript in draft and final form, and Larissa Brodsky assisted with the graphics. To all these, and particularly to the many unnamed individuals who gave of their time during interviews, I extend my thanks.

James McKellar
Professor of Architecture and Urban Design, University of Calgary, Calgary, Alberta
Associate Director, Center for Real Estate Development, Massachusetts Institute of Technology, Cambridge, Massachusetts

August 1985

TABLE OF CONTENTS

		Page No.
LIST OF TABLES		v
LIST OF FIGURES		vii
EXECUTIVE SUMMARY		ix
1.0	INTRODUCTION	1
2.0	AN OVERVIEW OF THE HOUSING SITUATION IN JAPAN	3
2.1	A Profile of the Housing Market	3
2.2	Distinguishing Features of the Japanese Housing Problem	20
2.3	Consumer Profiles and Preferences	
2.4	Land and Location	25
2.5	Patterns of Residential Investment	36
2.6	Financing the New Home Purchase	39
2.7	The Home Building Industry	43
3.0	GOVERNMENT POSTURE IN HOUSING	50
3.1	Five-Year Housing Programs	50
3.2	Promoting Industrialization in Housing	58
3.3	Ministry of Construction (MOC)	61
3.4	Ministry of International Trade and Industry (MITI)	63
3.5	Japan Development Bank (JDB)	67
3.6	Current Posture on Housing	69
4.0	INDUSTRIALIZATION IN THE HOUSING INDUSTRY	71
4.1	Prefabricated Housing in Japan	71
4.2	Current Status of the Industry	75
4.3	The Technical Appraisal System	84
4.4	Marketing the Product	89
4.5	Trends in Research and Development	95
4.6	2x4 Construction - A New Competitor	99
4.7	Conditions for Success	108

TABLE OF CONTENTS (continued)

Page No.

5.0 THE MAJOR PREFAB COMPANIES 112

5.1 The Top Five Producers 112
Sekisui House 112
Misawa Homes 119
Daiwa House Industry Co. Ltd. 131
National House Industrial 137
Sekisui Heim (Sekisui Chemical) 146

5.2 Other Competitors in the Field 156

Asahi Chemical 157
Kobori Juken 163

5.3 Foreign Activities and Overseas Subsidiaries 168

6.0 A COMPETITIVE FUTURE FOR INDUSTRIALIZED HOUSING 171

6.1 A Paradigm for Success 171
6.2 Some Things to Think About 181

BIBLIOGRAPHY 185

LIST OF TABLES

		Page No.
2.1.1	Changes In Urban and Rural Population	4
2.1.2	Changes in the Number of Housing Units and Households	5
2.1.3	Total Housing Starts - Japan, U.S.A., Canada	8
2.1.4	Primary Reasons for Being Dissatisfied with Present Housing (Nationwide)	10
2.1.5	Changes in Average Unit Size	11
2.1.6	Ownership of Housing	12
2.1.7	Housing Units by Type	13
2.1.8	Housing Units by Structure	15
2.1.9	Housing Starts by Type of Financing	16
2.1.10	Housing Starts by Tenure	17
2.1.11	Changes in the Housing Situation - Nationwide	18
2.2.1	Population, Area and Population Density	21
2.2.2	Residential Land Use in Japan	22
2.2.3	Japanese Household Accounts	24
2.3.1	Ownership of Consumer Durables by Japanese Households	28
2.4.1	Residential Land Price by Region	31
2.4.2	Changes in the Land Price Index	33
2.4.3	Average Commuting Time for Tokyo and Osaka	34
2.4.4	Standard of Housing	35

LIST OF TABLES (continued)

		Page No.
2.6.1	Outline of the Housing Loan Corporation's Housing Loans	41
2.6.2	Outline of Special Measures of Tax System for Owner-occupied and Rental Housing	44
3.1.1	Comparison of the Four Five-year Programs	51
3.1.2	Minimum Housing Standards	52
3.1.3	Average Housing Standards	53
3.5.1	Loans by the Japan Development Bank	68
4.1.1	Prefab Production by Unit Type	76
4.2.1	Prefab Production of Detached Units by Company	77
4.2.2	Prefab Production of Low-rise Apartments by Company	79
4.2.3	Total Production of the Top-five Prefab Companies	80
4.2.4	Comparison of the Top-five Prefab Housing Companies	81
4.2.5	Prefab Production of Detached Units by Type of Construction	85
4.2.6	Prefab Production of Detached Units by Unit Type and Company	86
4.3.1	Prefab Housing Systems by Type Approved by MOC	88

LIST OF FIGURES

		Page No.
2.1.1	Prefectures in Japan	19
4.6.1	Mitsui Show Home 1984	104
4.6.2	Mitsui Homes - 2x4 Wood Platform Construction	105
4.6.3	Mitsui Homes - 2x4 Wood Framing Details	106
5.1.1	Sekisui House Show Home 1984	114
5.1.2	Sekisui House - Light-gauge Steel Framing System	115
5.1.3	Sekisui House - Typical Wall Section	116
5.1.4	Misawa Homes - Organizational Structure	121
5.1.5	Misawa Homes - Prefabricated Wood-panel System	123
5.1.6	Misawa Homes - House 55 Using PALC	124
5.1.7	Misawa Homes - Module System Using PALC Panels	125
5.1.8	Daiwa House Show Home 1984	134
5.1.9	Diawa House - Steel Framing Section	135
5.1.10	Daiwa House - Typical Wall Section	136
5.1.11	National House Show Home 1984	140
5.1.12	National House - House 55	141
5.1.13	National House - Steel Framing System	142
5.1.14	National House - Typical Wall Sections	143
5.1.15	Sekisui Heim Show Home 1984	149
5.1.16	Sekisui Heim - General Construction	150
5.1.17	Sekisui Heim - Typical Wall Section and Details	151
5.1.18	Sekisui Heim - Layout of the Production Process	152
5.1.19	Seikisui Heim - Floor Plans, M3 PARFAIT	155
5.2.1	Asahi Chemical - Hebel Show Home, 1984	159

LIST OF FIGURES

		Page No.
5.2.2	Asahi Chemical - Steel Framing System and PALC Panel System	160
5.2.3	Asahi Chemical - Typical Wall Section	161
5.2.4	Kobori Juken Show Home, 1984	165
5.2.5	Kobori Juken - House 55	166
5.2.6	Kobori Juken - Prefabricated Wood-panel System	167

EXECUTIVE SUMMARY

There is increasing evidence of industrialization within the housing industry, not just in the sense of factory-produced housing but including the application of industrial production procedures to a myriad of products that the consumer now assembles to create an appropriate living environment. Not surprisingly, those who are sensitive to such changes are being directed toward a country that has already changed our thinking about technology in the home, Japan. It is in Japan today that we can glimpse an enviable future for the housing industry and already see tangible results of industrialized housing production directed specifically at the single family detached house. The study attempts to convey what is happening in the prefab housing sector, as the Japanese prefer to call it, the reasons for apparent successes, and finally, what this experience may provide for our own changing industry.

The study is primarily based upon extensive field work in Japan, including site visits to factories and show homes and interviews with industry people, government officials, and spokesmen for various housing organizations. Relevant literature on the subject is scant, usually outdated, and often seriously misleading. Background reading on the social, cultural, and economic factors in Japan are essential for coping with the results of the field investigations, but there is always a hazard in speculating on the very limited resources that this study has touched upon. The actual synthesis was greatly assisted by subsequent discussions with colleagues in industry and government, and the Japanese propensity to generate all kinds of data was invaluable in corroborating the findings.

Industrialized housing in Japan is not a new phenomenon, and today's results are the fruits of a concerted effort that dates back some thirty years. The market share for prefab housing stood at 15.3 percent of total housing starts in 1983, and this effort is primarily the work of just five companies, accounting for 80.5 percent of all prefab starts.

Of the approximately 174,000 prefab units produced in 1983, 53 percent were single-family detached, 32 percent were two-storey walk-up apartments, and only 15 percent were high-rise buildings. The remainder of the home building industry is surprisingly similar to that found in North America: some one hundred thousand builders building traditional houses and struggling with declining housing starts and a declining share of those starts. This trend is in marked contrast to the recent trend among the top five prefab housing companies.

A number of factors have contributed to the relative longevity of the prefab housing industry in Japan and its more recent successes. These reasons go well beyond geographic and market factors and touch upon the relationship between government and large industry in Japan, the commercial banking system and preferable loan rates, the subcontracting system, and a business structure indicative of large organizations in Japan that is foreign, if not alien, to both government and industry in North America.

Industrialized housing in Japan is a product that sells well in densely populated urban centres, particularly the single-family detached house in a situation where a substandard unit is being replaced. This situation requires individual designs to fit a particular lot, site erection with a minimum of on-site labour due to lack of space for storage of materials, and the enforcement of rigorous earthquake and fire protection standards. Over 65 percent of such prefab units use a light gauge steel framing system and some form of composite, nonload bearing wall panel. A prestressed wood panel system shares the remainder of the market. These are home builders who extol the virtues of custom-designed detached housing, the "free-style" plan, one-of-a-kind products and design features, and materials of the highest quality. If the mobile home is the trademark of industrialized housing in North America, the large, somewhat expensive, custom-designed urban home is rapidly assuming the comparable trademark for this industry in Japan.

The prefab housing industry in Japan is now oriented toward marketing total living environments, not just buildings, and including appliances, furniture, fixtures, and equipment. It views itself as having a continuing involvement with its customers in changing, modifying, and adapting the home following its initial sale--these prefab housing companies have realized that the initial sale is only the beginning of a long and profitable relationship between producer and consumer. Obviously, this approach requires an organizational structure that extends far beyond what we normally deem to be a housing company and represents an integration of functions and services that approaches one-stop shopping.

The Japanese have achieved notable market success with prefab housing, and, of course, this prompts the obvious question "What does this mean for us?" It is highly unlikely that the Japanese prefab companies will begin to unload houses at North American ports along with cars, appliances, and electronic goods. However, while we may not see the actual products of Japan's prefab housing companies arrive on our shores, we could well see the products of its research and development spending, which is considerable, through licensing agreements with off-shore companies. More significantly, we may well see adoption of Japanese software before the hardware systems that seem to lure the current housing expeditions to that country.

It is in the area of management, sales, and organizational skills where new opportunities abound. The influence could well be felt in the way that North American home builders choose to do business in the future. The integration or "rationalization" of the industry in Japan and its vision of housing as a consumer product, extending far beyond the building itself, could have an impact on our domestic companies. Franchising, after-sales follow-up, ventures into renovation markets, alliances with appliance or furniture companies, show-home parks downtown, interior design services, and increasing factory production of value-added components may begin to emerge in some form but not likely within as comprehensive a framework as we now see in Japan.

The recent and very strong interest in 2 x 4 wood frame housing construction by the two largest industrial conglomerates in Japan could have a major impact both in Japan and North America. If one combines the standard 2 x 4 wood frame building system with the overall approach to the housing industry developed by these prefab housing companies, as is the case with Mitsubishi and Mitsui, then perhaps we have a glimpse of the future, at least in North America and possibly in foreign markets as well.

The impending threat from the Japanese housing industry, if such a threat even exists, is not so much one of increased domestic competition but lost opportunity for a building system that North Americans have successfully used since World War II, 2 x 4 wood frame construction. Competition from Japan could well be felt in foreign markets such as Pacific Rim countries, and it would indeed be ironical if they gained the competitive edge with our very own housing system.

Japanese industrialized housing represents, on one hand, a set of products and, on the other hand, a very different way of thinking about the housing industry, perhaps along the lines a global competitor may wish to think. Hopefully, this work will encourage some new thinking about the housing industry per se and will precipitate an interest in reviewing the role of industrialization as an essential ingredient of this industry.

1.0 INTRODUCTION

In 1983, five Japanese companies factory-produced 73,485 detached units of housing, some 80 percent of which were custom designed. The largest of these five companies produced more than double the annual production of the largest home builder in the United States in 1983. Industrialized or manufactured housing now accounts for 15 percent of all housing starts in Japan, and this market share could rapidly increase. These industrialized home builders are massive corporations by North American standards, distinguished by their vertically integrated structure which combines factory production, advertising and marketing, research and development, financing, sales, construction, and servicing--all within a single entity.

This work provides some insight into these companies and Japan's recent successes with industrialized housing. My curiosity was first aroused by a series of news articles that appeared in North American journals in 1983. They extolled the virtues of the instant factory house soon to arrive upon our shores from Japan, along with cars, cameras, and appliances. Fortunately, there was more than sufficient substance behind the misleading headlines to justify a critical look at just what the Japanese were doing in these housing factories.

Due to the paucity of written material available in English, the work has relied almost exclusively on field-work in Japan and on the goodwill of industry and government spokesmen who gave such unexpected support during the course of my visit to Japan. Constant dialogue with colleagues at MIT and Harvard and with my sponsors in Alberta and Ottawa served to focus and refine my findings and conclusions as the work progressed. One must recognize the limitations imposed by the language and culture of Japan on such field-work, and my own biases in first structuring the interviews and then interpreting the results will no doubt be evident. Surprisingly, my hosts did provide excellent material and

data, in English, to corroborate statements and seldom, if ever, did proprietory interests or confidentiality inhibit my investigation.

The report is organized into five main sections. Chapter two provides an overview of the current housing situation in Japan, and sets the context; chapter three follows with an examination of the government's involvement in promoting industrialized housing; chapter four focusses on the prefabricated housing industry and conditions for its success; chapter five describes the major companies involved and their products, and, finally, chapter six concludes with observations on the implications of the Japanese experience, nationally and internationally.

This foray into a most complex topic will no doubt be critically examined and challenged by those who also seek to better understand our own housing industry and its future prospects. I would hope these critics can share my preoccupation with a set of questions that initiated this investigation: What changes might we expect in the way we build houses? What do these changes imply for the increased role of industrialization in housing production? and, What might be the impact of these changes on the housing industry itself and the consumers of the products of this industry?

2.0 AN OVERVIEW OF THE HOUSING SITUATION IN JAPAN

2.1 A Profile of the Housing Market

An overview of the housing situation in Japan, post-World War II, provides evidence of the latent potential for success of industrialized housing in this country. When the war ended in 1945, 4.2 million dwelling units were required throughout Japan to replace those devastated by the war, and this figure was further exacerbated by the rapid migration of rural dwellers to the cities following the war. This migration to the cities increased urban dwellers from 37.3 percent of the population in 1950 to 76.2 percent in 1980 (table 2.1.1). The monumental task of rehousing the nation following World War II imparted a sense of urgency to housing production that lasted well into the 1970s and maintained an awareness of both the demand and supply side of housing on the part of government and industry that continues even today.

Fundamental changes in post-war housing policy did not occur until the mid 1960s and was to coincide with the remarks of a sharp-tongued Common Market official, Sir Roy Denham, who scornfully referred to post-war Japanese housing as "rabbit hutches". These remarks were seen as being as influential as the potent impact of the oil shocks of the 1970s and had a certain bitter currency among Japanese households who were just beginning to realize that housing quality and not quantity was now the notable housing problem.

The actual shortage of housing was redressed as early as 1968 when the number of dwelling units on a national basis exceeded that of households (table 2.1.2). Regional disparities disappeared by 1973 when the number of dwelling units exceeded that of households in every prefecture and, in the governments' estimates, original housing objectives had been achieved. But solutions to mass housing problems were not

Table 2.1.1

Changes in Urban and Rural Population

	Urban (%)	Rural (%)
1920	18.0	82.0
1930	24.0	76.0
1940	37.7	62.3
1950	37.3	62.7
1960	63.3	36.7
1970	72.1	27.9
1980	76.2	23.8

Source: Bureau of Statistics, Prime Minister's Office, Japan, 1980.

Table 2.1.2

Changes in the Number of Housing Units and Households

Year	1958	1968	1978
Total households (1,000)	18,647	25,320	32,835
Total dwelling units (1,000)	17,934	25,591	35,451
Dwelling units per household (%)	0.96	1.01	1.08
Vacancy (%)	2.0	4.0	7.6

Source: Housing Survey of Japan, Bureau of Statistics, Prime Minister's Office, 1978.

without social and environmental costs. The general housing theme of the past twenty-five years brought with it new problems pertaining to housing quality and the quality of residential environments themselves. Sir Roy Denham's comment reflected what officials had already suspected; Japan's housing problem for the seventies and eighties became one of addressing issues of space, overcrowding, sunlight, and the like. However, the Japanese government was quick to recognize the issue of housing quality and realized that if it wanted to gain recognition as a world economic power it must set about creating a housing industry that would parallel its predecessors in the automobile and electronics industries.

Housing in Japan, as in any country, is influenced by such factors as climate, natural resources, and social structure. In the case of Japan, these have led to a very distinctive and traditional housing form and method of construction with deep historical roots. The traditional Japanese house stands in marked contrast to the danchi, the high concrete apartment blocks built in the 1960s and 1970s that surround major urban centers and that now serve as constant reminders to government of the dysfunction between housing demand and supply. It is the traditional penchant for the detached house and not the high-rise apartment that is guiding today's search for housing quality.

The influence of moderate climates in central and southern Japan and the abundance of good quality wood shaped an open style post-and-beam detached house form in marked contrast to the closed style western house using brick or stone bearing walls to defend against harsh winter climates. But recent social changes have done much to transform the traditional Japanese open model to that resembling the western style closed model. We now see a contemporary Japanese home that varies little in appearance both inside and outside from its Western counterpart, save for the tatami room reserved for ceremonial occasions and the comfort of elders in the home.

The Japanese household today aspires to own a home that, at first glance, would appeal to Europeans and North Americans alike. This aspiration perhaps symbolizes the changing nature of a highly sophisticated urban population who have cast themselves amidst an international matrix of consumer labels, many of which they now produce. Political awareness has certainly ensured that the detached single-family house is the backbone of government housing policy and a primary focus of the housing industry today. That is not to imply that qualitative improvements are not being sought in other housing forms, particularly the low-rise or walk-up apartment. But annual surveys have underscored the heightened desire of Japanese households to become homeowners. Amongst households living in rental accommodation, an incredibly high 89 percent (1978) see the way to improving their present housing situation as through ownership of their own detached dwelling.

Against a backdrop of high level economic growth and an overwhelming demand for housing in the early 1970s, the number of new housing starts in Japan soared to a record high of 1.86 million in 1972. This compares to a high of 2.38 million in the United States (with almost twice the population) set in the same year and a Canadian record of 273,000 starts set in 1976 (table 2.1.3). However, the peak was short-lived, and the first oil crisis in the fall of 1973 led to a sharp slump that did not show signs of recovery until 1975. Starts in the 1980s have begun to stabilize in the 1.1 million range, although some forecasts see a further drop into the seven hundred thousand unit range in the later part of the decade.

Table 2.1.3

Total Housing Starts - Japan, U.S.A., Canada (1,000)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Japan[1]	1,532	1,856	1,763	1,261	1,428	1,530	1,532	1,498	1,487	1,214	1,143	1,157	1,137
U.S.A.[2]	2,085	2,379	2,058	1,353	1,171	1,548	990	2,023	2,046	1,529	1,329	1,312	2,007
Canada[3]	234	250	269	222	231	273	246	228	197	159	178	126	163

Source:

1. Housing Survey of Japan.
2. Department of Housing and Urban Development (includes HUD code mobile homes).
3. Canadian Housing Statistics, Canada Mortgage and Housing Corporation, 1984.

[ ] Highest annual housing starts

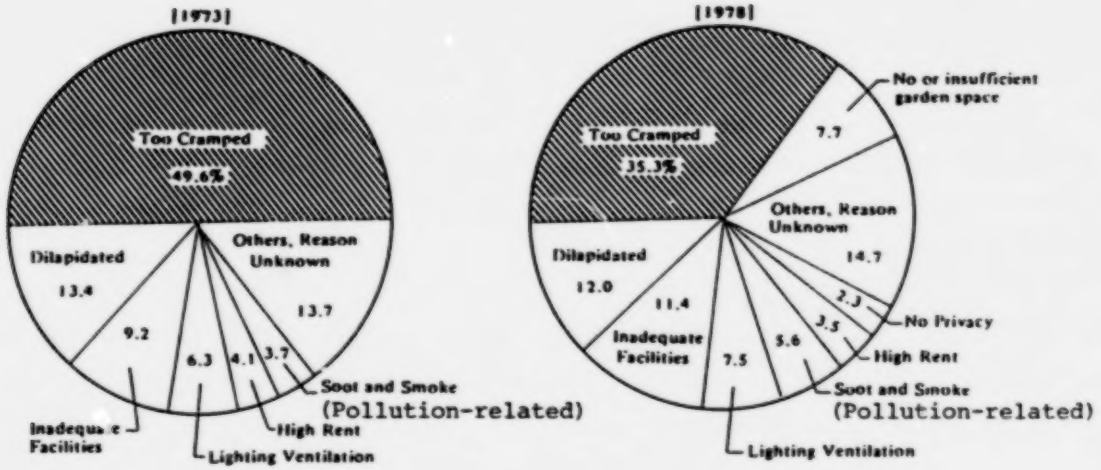
Concomitant with a significant drop in starts from earlier record years and a movement toward a more stabilized annual production, there has been a steady expansion in the size of dwellings constructed in Japan. This is indicative of the search for improved housing quality through increased living area and a response to the most frequently voiced complaint in annual housing surveys, that existing housing is too cramped (35.3 percent of all respondents in 1978, table 2.1.4). In the period 1968 through 1978, the floor space per dwelling constructed increased from 73.86 m^2 to 80.28 m^2 for all unit types and from 97.42 m^2 to 106.16 m^2 for owner-occupied homes (table 2.1.5).

As far as tenure is concerned, the percentage of owned homes reversed a downward trend that followed a 1958 high of 71.2 percent and stood at 60.4 percent in 1978 (table 2.1.6). In 1982, 69.3 percent of all starts were owner-occupied presold units or units for sale. The reversal can be attributed to the increase in the percentage of owned homes constructed in large metropolitan areas either as replacement units or condominiums.

With a homeownership percentage similar to that found in North America (in 1982, 63 percent of Canadian households were homeowners), it is not surprising, therefore, to find that 65.1 percent (1978) of all housing starts were single-family detached, with 9.6 percent in tenements (two or more attached units, each with independent entry to the street) and 24.7 percent in apartments (two or more stacked units with shared stairways and halls (table 2.1.7). The high proportion of single-family and tenement units accounts for the predominance of wood construction. In 1978, 81.6 percent of all starts used a wood structure, of which 25.4 percent used fireproof

Table 2.1.4

Primary Reasons for Being Dissatisfied with Present Housing (Nationwide)



Source: Housing Demand Survey, Housing Bureau, Ministry of Construction, 1978.

Table 2.1.5

Changes in Average Unit Size (m^2)

Year	Total Size	Owner-Occupied Units	Rental Units	Breakdown of Rental Units		
				Public Rental	Private Rental	Issued Housing [1]
1968	73.86	97.42	38.05	37.78	43.94	53.56
1978	80.28	106.16	40.64	42.05	40.67	55.33

Source: Housing Survey of Japan, 1978.

1. Company housing rented to employees.

Table 2.1.6

Ownership of Housing, 1,000 Units (%)

Year	No. of Dwelling Units	Owner Occupied Housing	Total Rental Housing	Breakdown of Rental Units		
				Public Rental Housing	Private Rental	Issued [1] Housing
1958	17,432	12,419	5,013	614	3,233	1,166
	(100.0)	(71.2)	(28.8)	(3.5)	(18.5)	(6.7)
1968	24,198	14,594	9,604	1,403	6,527	1,674
	(100.0)	(60.3)	(39.7)	(5.8)	(27.0)	(6.9)
1978	32,117	19,428	12,689	2,442	8,409	1,839
	(100.0)	(60.4)	(39.4)	(7.6)	(26.1)	(5.7)

Source: Housing Survey of Japan, Bureau of Statistics, Prime Minister's Office, 1978.

1. Company housing rented to employees.

Table 2.1.7

Housing Units By Type, 1,000 Units (%)

Year	No. of Dwelling Units	Detached Units	Tenement[1] Units	Apartment[2] Units	Others
1968	24,198	16,102	3,564	4,449	83
	(100.0)	(66.5)	(14.7)	(18.4)	(0.3)
1978	32,189	20,962	3,103	7,963	161
	(100.0)	(65.1)	(9.6)	(24.7)	(0.5)

Source: Housing Survey of Japan, Bureau of Statistics, Prime Minister's Office, 1978.

1. Low-rise, walk-up units, 2-3 storeys.

2. High-rise units.

wooden construction. The proportion of wooden structures in 1978 is down from 91.5 percent in 1968 (table 2.1.8). In 1982, 50.3 percent of all housing starts (1.16 million) were publicly financed, with the remainder being privately financed (table 2.1.9). This represents a long trend of increased public financing from a low of 21.9 percent in 1973 and a rather rapid increase over the past five years. Of total starts in 1982, 49.6 percent were owner-occupied units, 30.7 percent were rental or issued units, and the remainder, 19.6 percent, were units built for sale (table 2.1.10).

The housing problem is far from being solved in Japan, and in 1978 there were still 4.75 million households in accommodation that failed to meet "minimum housing standards" as defined by the Ministry of Construction[1] (14.8 percent of total households) and 18.75 million households occupying housing that fell below "average housing standards" (58.3 percent of total households, table 2.1.11).

The current level of approximately 1.1 million housing starts can be broken down roughly into six hundred thousand single family detached units (55 percent) and five hundred thousand attached units (45 percent), which compares to 65 percent single family detached and 35 percent attached units in the United States. Of the six hundred thousand units, approximately four hundred thousand are replacement units for existing stock (36 percent of total starts) and two hundred thousand are detached houses built on new lots. The five hundred thousand attached units are broken down into two hundred thousand low-rise units (predominately two stories) and three hundred thousand high-rise units (27 percent of total starts).

---

1. See tables 3.1.2 and 3.1.3.

Table 2.1.8

Housing Units By Structure, 1,000 Units (%)

Year	No. of Dwelling Units	Wooden Structures	Fireproof Wooden	Others
1968	24,198	18,614	3,537	2,047
	(100.0)	(76.9)	(14.6)	(8.5)
1978	31,864	18,104	8,184	5,576
	(100.0)	(56.2)	(25.4)	(17.3)

Source: Housing Survey of Japan, Bureau of Statistics, Prime Minister's Office, 1978.

Table 2.1.9

Housing Starts By Type of Financing, 1,000 units (%)

	1973	1975	1979	1980	1981	1982
Publicly Financed	386	428	612	544	539	582
	(21.9)	(30.0)	(41.1)	(44.8)	(47.1)	(50.3)
Privately Financed	1,378	1,000	875	670	604	576
	(78.1)	(70.0)	(58.9)	(55.2)	(52.9)	(49.7)

Source: Statistics on Housing Starts, Ministry of Construction, 1982.

Table 2.1.10

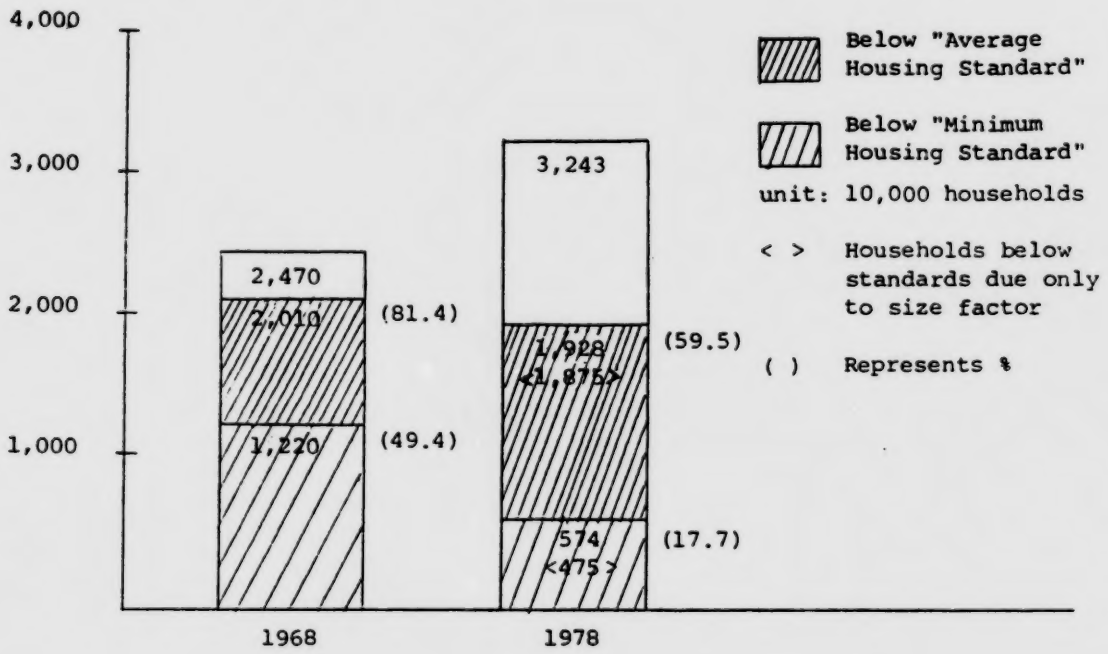
Housing Starts By Tenure, 1,000 units (%)

	1973	1975	1979	1980	1981	1982
Owner Occupied	756	730	714	583	557	574
	(42.9)	(51.1)	(48.1)	(48.0)	(48.7)	(49.6)
Rental and Issued	658	446	426	320	329	356
	(37.3)	(31.3)	(28.6)	(26.4)	(28.8)	(30.7)
For Sale	349	251	346	311	257	227
	(19.8)	(17.6)	(23.3)	(25.6)	(22.5)	(19.6)
Total Starts	1,763	1,427	1,486	1,214	1,143	1,157

Source: Statistics on Housing Starts, Ministry of Construction, 1982.

Table 2.1.11

Changes in the Housing Situation - Nationwide, 1,000 units (%)



Source: Estimates by Ministry of Construction based on Housing Survey of Japan, 1978.

Notes

1. "Average Housing Standard" and "Minimum Housing Standard" are defined by the Ministry of Construction, see tables 3.1.2 and 3.1.3.

2. Households below housing standards are determined not only by size but by other factors such as presence of boarders (or sharing), shared facilities, old and/or dilapidated housing, and if the unit was originally built for residential use. The 1978 figures in < > are based on the number of households below housing standards only due to size factor.

Figure 2.1.1

Prefectures in Japan

A figure that certainly reinforces this nation's commitment to a strong housing industry is actual housing investment as a percentage of the nominal GNP. Japan has the world's highest rate at 7.6 percent (1978), versus 4.8 percent for the United States (1979), and has averaged over 8 percent for the past decade, almost double the U.S. average.

2.2 Distinguishing Features of the Japanese Housing Problem

While the Japanese family aspires to own a single-family house, there are significant constraints that make the current rate of single-family purchase in Japan all the more surprising. The most formidable constraint is the lack of land for building, with the existing high densities to be found in the metropolitan areas. It is in spite of these densities that government housing policy still attempts to respond to the overwhelming wish to urban dwellers to own their own home and vacate the rental apartment or danchi. In a 1983 government survey of the aspirations of large city dwellers, 89 percent aspired to own their own single-family home and 51 percent of these same dwellers were prepared to commute for forty-five to sixty minutes to do so.

Japan is not only a narrow land mass but the greater part of it is covered with mountains and forests. Less than 18 percent of the total area is suitable for habitation (table 2.2.1), and as a result dwellings occupy only 3.8 percent of the total land area (table 2.2.2). With an overall population density of 316 persons per square kilometre (1983) compared with twenty-five for the U.S. and two for Canada, the impact of land scarcity is always foremost among government concerns. A further consequence of this lack of habitable land is the concentration of population in the Tokyo, Osaka, and Nagoya corridor. These three regions account for approximately 6 percent of the total land area of Japan but accommodate 42 percent of the country's population. Population density in a

Table 2.2.1

Population, Area, and Population Density (1983)

	Population (millions)			Area (% of total)			
	Mid-year Estimate	Forecast for 2000	Annual Rate of Increase 1975-82	Agriculture	Forest and Woodland	Other	Population Density (persons/km^2)
Japan	119.26	129.28	0.9 %	14.8	66.8	18.4	316
U.S.A.	233.70	263.83	1.0 %	45.7	30.4	23.9	25
Canada	24.91	31.50	1.1 %	7.0	32.7	60.3	2

Source: Japan 1984, An International Comparison, Japan Institute for Social and Economic Affairs, 1984.

Table 2.2.2

Residential Land Use in Japan (1981)

	Nationwide	Three Metropolitan Regions
Residential Land	3.8%	11.2%
Housing Use[1]	2.9	8.4
Industrial Use[1]	0.4	1.3
Offices, Stores[2]	0.5	1.5

Source: National Land Agency, 1981.

1. Land zoned residential and occupied by housing.
2. Land zoned residential and occupied by industrial or commercial uses.

fifty kilometre radius of Tokyo, for example, rises to 3,254 persons per square kilometre. Fortunately, population growth is no longer compounding the density problem. The national birth rate has shown a constant drop, except for one upsurge in the "baby boom" period immediately after the war. However, one factor that has affected housing demand is the increasing age of the population. Japan's annual rate of population increase for the period 1974 to 1982 was 0.9 percent as compared to 1.0 percent for the U.S. and 1.1 percent for Canada during the same period. Life expectancy for males has risen from 65.32 to 74.20 in the period 1960 to 1983, and the Japanese now enjoy the longest life expectancy in the world today.

Population density in Japan is a severe constraint to achieving consumer expectations and inevitably results in small building lots, cramped and crowded housing conditions within cities, and extraordinary land values throughout the metropolitan regions. These are factors that distinguish the Japanese housing problem from its Western counterpart and directly influence the housing industry. On the other hand, Japanese housing consumers are surprisingly similar to Westerners in their expectations and preferences for housing.

The annual gross earnings of a typical worker in Japan (1982), defined as male, manufacturing sector worker with two children and a wife who is not working, is $17,099 U.S. compared with $17,887 U.S. in Canada and $17,136 in the U.S.[2] The household income (1983) of a salaried worker household is $20,484 U.S. (4,865,359 yen) or $1,707 monthly, of which $1,449 (85 percent) is disposable income (table 2.2.3). Living expenses consume 79 percent of this disposable income, housing represents 10.1 percent, and food and drink 30.0

---

2. OECD, "The 1982 Tax/Benefit Position of a Typical Worker in OECD Member Countries."

Table 2.2.3

Japanese Household Accounts (1983)

	Per Month (Yen)	(US$ = 237.52 yen, 1983)
Income [1]	405,517	1,707
Regular [2]	263,155	1,108
Temporary and bonuses [2]	74,239	313
Disposable Income	344,113	1,449
Living Expenditures	272,199	1,146
Food	72,099	304
Housing, fuel, light	28,703	121
Clothing, footwear	18,910	80
Medical care	6,436	27
Education	10,414	44
Reading and recreation	23,462	99
Propensity to Save [3]	20.9%	

Source: Japan 1984, An International Comparison, Japan Institute for Social and Economic Affairs, 1984.

1. Salaried worker household (3.79 persons).

2. Household head only.

3. Propensity to save is defined as the percentage remaining of disposable income after living expenses.

percent. Comparable figures for housing and food and drink in the United States are 24.5 percent and 20.9 percent, respectively.

There is one particular feature that certainly distinguishes Japanese householders--their propensity to save, for which they maintain first ranking in the world. This propensity to save stands at 20.9 percent and net savings realized is averaging more than 17 percent of after-tax income (1984). In comparison, the U.S. household's net savings realized is now averaging 6 percent of after-tax income.[3] However, even with the acumen for saving, the Japanese household still finds home purchase a formidable task. According to a survey by the Economic Planning Agency, the purchase price of a house was 7.17 times larger than the annual disposable income of an average worker's household in a large city in 1975. This figure dropped slightly in 1977 but increased to reach 11.1 times in 1982 (approximately $185,000 U.S.). Since housing loans are dependent on household income, it is becoming increasingly difficult for the average family to obtain a house even with mortgage loans.

2.3 Consumer Profiles and Preferences

Who is the typical customer for a single-family house? The level of generalization that this question implies could be misleading. However, there are certain characteristics that begin to emerge on a relatively consistent basis. Even more important are the trends that are now emerging among home buyers, so profiles should not be viewed independently from emerging trends. One must first distinguish between the urban versus rural customer. The cities of Tokyo, Osaka, and Nagoya make up the majority of the consumer market in Japan, and it

---

3. Asian Wall Street Journal, 31 July 1985.

is this market to which reference is made. This concentrated market area is situated at about thirty-five degrees north latitude, which is much farther south than London, Paris, or Berlin (fifty degrees) or even New York, Madrid, or Rome (forty-two degrees).

A typical single-family purchaser in the urban market is likely to have a combined household income in the range of $22,000 U.S. to $25,000 U.S. (55 to 62.5 million yen), and the head of the household will be thirty-five to forty years old. The median age of the Japanese home buyer is 37.5 years versus twenty-nine years in the U.S. The family likely is occupying a rental apartment or house and has been saving diligently for the past ten to fifteen years. The move is precipitated by the fact that their two teenage children now require more private space, particularly a quiet place for studying, and the father's parents have decided that they can no longer maintain their house and will now move in with the eldest son. The family is fortunate in that they will not have to contend with purchasing a lot (likely some sixty to ninety minutes commuting time from Tokyo). They will be demolishing the original home occupied by the grandparents and replacing it with a new home. The new home will then accommodate the three generations. This will be a once-in-a-lifetime purchase for the family--it will certainly not be viewed as a starter home with expectations of moving up in the housing market in three or four years, as one would expect to find in North America. Most important, the new house will maintain the family's historical ties to the family plot.

The home itself will be quite different from that of the grandparents and will contain a number of features attractive to the two teenage children. Most discernible will be evidence of the trend toward Westernization that will have already affected every aspect of the family, including their dress, their eating habits, and their living patterns.

This trend is indicative of a belief among Japanese consumers that Westernization is equivalent to modernization and an international image. No doubt the steady rise in the number of Japanese who travel abroad and gain experience as residents in foreign countries has further influenced this trend.

The house is a consumer good, and the family will likely approach this purchase as it has the abundance of other material goods it has already acquired. First of all, the house must be an original product of top quality and with long service life. Second, it must satisfy individual tastes, not so much in terms of quality or durability but in terms of its capacity to satisfy the personal sentiments of family members spanning three generations.

Already the family will have enjoyed the use of a refrigerator, electric washing machine, vacuum cleaner, colour TV, stereo phonograph and tape deck, and a sewing machine (table 2.3.1). They might have a car and even use an air conditioner in the summer months. These purchases have already conditioned the expectations of the family and the house is no longer just a shelter item; it is the very foundation for an economically stable, healthy, and harmonious family life and a symbol of a rising standard of living.

The Western influence that the family seeks to emulate will be evident from the exterior appearance of the house through to furniture, fixtures, and appliances. The layout will emphasize a family living room and dining area and will provide a bright, functional kitchen for the wife and private bedrooms for each child. Room sizes will be considerably larger than the grandparents are accustomed to but they will still be laid out in a familiar functional manner using built-in storage and furniture wall units to free up floor space. The open-air system of the traditional house will be replaced with closed-house features such as sash windows and a

Table 2.3.1

Ownership of Consumer Durables by Japanese Households (1984)

	Ownership[1] Ratio (%)	No. per 100 homes
Colour TV sets	99.2	163.8
Refrigerators	98.7	116.1
Washing machines	98.4	105.5
Vacuum cleaners	96.7	115.7
Cameras	85.7	128.2
Kerosene heaters	85.6	160.6
Sewing machines	80.2	90.0
Passenger cars	64.8	79.2
Stereos	58.0	62.3
Air Conditioners	49.3	75.2
Microwave ovens	40.8	41.2
Golf sets	23.7	27.5
Video recorders	18.7	19.5
Pianos	17.6	17.9

Source: Economic Planning Agency, Japan, 1984.

1. Percentage of homes possessing the item.

sealed exterior enclosure. Unfortunately, this system will not provide the same level of natural ventilation during the hot humid summers, and condensation and mould in and on the exterior walls could be a problem during the cold winter months, especially in Hokkaido.

There will be few rooms, if any, with the traditional tatami mats on the floor, but more rooms will have carpets or wood floors upon which are placed chairs, desks, and other Western furniture. Even the traditional futon will be replaced with beds and the shoji (sliding partitions) will give way to hinged doors.

Some traditional customs will not disappear but will be adapted to this new Western style: family members will still remove their shoes at the door and the carpet will be viewed not as part of the floor but as an extension of the tatami mat. While bathroom fixtures may look familiar to a Westerner, the method of bathing in Japan will remain distinctively Japanese and preclude the use of shower stalls; bathing shall always remain a perplexing procedure to foreigners arriving in Japan for the first time. Western style flush toilets, while gradually replacing the traditional Japanese squatting toilets, will never occupy the same room where bathing takes place. However, there is now a Japanese version of the French bidet that combines functions in a rather technical-looking contraption.

Structural changes in life style are taking place rapidly, and facts and figures could not convey the impact that these are having now on housing as a consumer good. What is certain is that the Japanese family, in spite of severe restrictions on their ability to replicate the home-buying habits of their North American counterparts, are exhibiting tendencies which significantly diminish the cultural distinctions that once prevailed between the two cultures.

2.4 Land and Location

The land question in Japan is very complex and deserves its own study. It is sufficient to say here that the cost of residential land, a building lot, is horrendous by Western standards and presents an almost insurmountable constraint to homeownership in large metropolitan areas. If Japan has earned an exemplary reputation for improving the quality of the house, its reputation for coping with land cost is diametrically opposite. In all discussions on housing cost with government and industry, price refers exclusively to the house, not the lot, perhaps reflecting a sense of embarrassment of even discussing the issue of land. This omission is somewhat ironic when discussing with housing producers the means to further reduce production costs of the housing unit. Any such reductions seem insignificant in comparison to the record of increasing land costs. For example, average residential land costs in 1982 rose 19.4 percent over the previous year in Tokyo and 16.6 percent and 24.1 percent in Osaka and Nagoya, respectively.

With average residential land costs in 1980 in the order of $811 U.S./$m^2$ (183,900 yen) in the Tokyo region, $688 U.S./$m^2$ (156,000 yen) in the Osaka region, and $408 U.S./$m^2$ (92,500 yen) in the Nagoya region (US$ = 226.74 yen, 1980), it is not difficult to comprehend the hurdle of purchasing land and building a new house even with the availability of low interest loans (table 2.4.1). As a result, applicants for loans to the Housing Loan Corporation are usually persons who have obtained land through donation or succession, usually from the family plot, that is, purchasers not carrying a substantial debt for land acquisition. It should also be noted that the above figures are averages computed over a 60 kilometre radius from downtown Tokyo, 50 kilometres for Osaka, and 40 kilometres for Nagoya. Residential land values for single family lots in Tokyo can

Table 2.4.1

Residential Land Price by Region (Yen/m^2)

City	Radius	1982	1983	% Change
Tokyo	60 km	154,400	183,900	+19.1
Osaka	50 km	133,900	156,000	+16.5
Nagoya	40 km	73,000	92,500	+26.7

Publicized Land Price: National Land Agency, Japan Institute of Real Estate, 1978.

approach $3,000 U.S./$m^2$ (680,220 yen) within thirty minutes travelling time from Tokyo Station (1980 figures).

As an overall trend, land prices for the six large cities based on a 1955 index of 100 rose to an index level of 7,412 in 1984, versus a Consumer Price Index of 498 on the same basis (table 2.4.2). After a relative slackening of land prices following the consequences of the first oil shock in 1973, land prices have continued to rise, and from 1979 onward the annual rate of increase in large cities has been particularly conspicuous, continually reaching double-digit percentages.

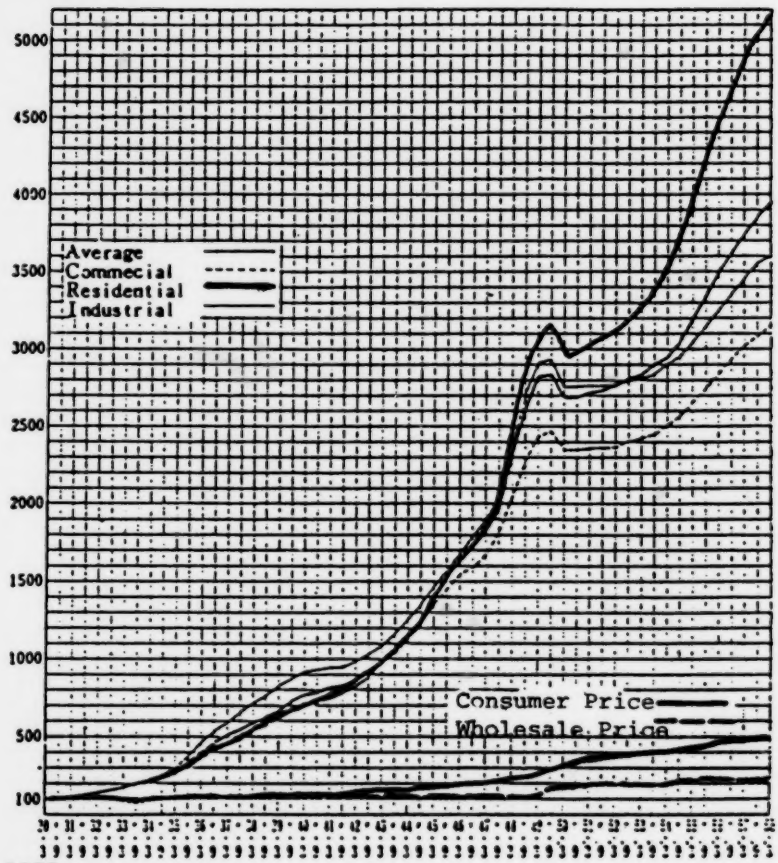
The influence of land availability and land cost can be seen on commuting times (table 2.4.3). In Tokyo (1980), 39.4 percent of households commute an average of sixty to ninety minutes to work and 16.6 percent commute ninety to 120 minutes. In Osaka, 50.9 percent commute thirty to sixty minutes and 36.2 percent commute sixty to ninety minutes. The comparable figures for Nagoya are 44 percent and 37 percent respectively.

Whereas the average lot size per detached unit was 299 m^2 (1978) nationwide, this figure drops to 176 m^2 in Tokyo and 152 m^2 in Osaka (table 2.4.4). This translates into an average cost of approximately $142,736 U.S. (32,363,960 yen) in the Tokyo region and $104,576 U.S. (23,711,562 yen) in the Osaka region, given 1980 figures. It must be remembered, however, that there has been substantial inflation of land prices since 1980, and even at $142,736 U.S. the lot may well be ninety minutes from downtown Tokyo.

Home building in Japan, unlike North America, does not rely on new subdivisions for the supply of lots. There is the initial difficulty in obtaining land for development, and this is further compounded by the difficulty in converting productive

Table 2.4.2

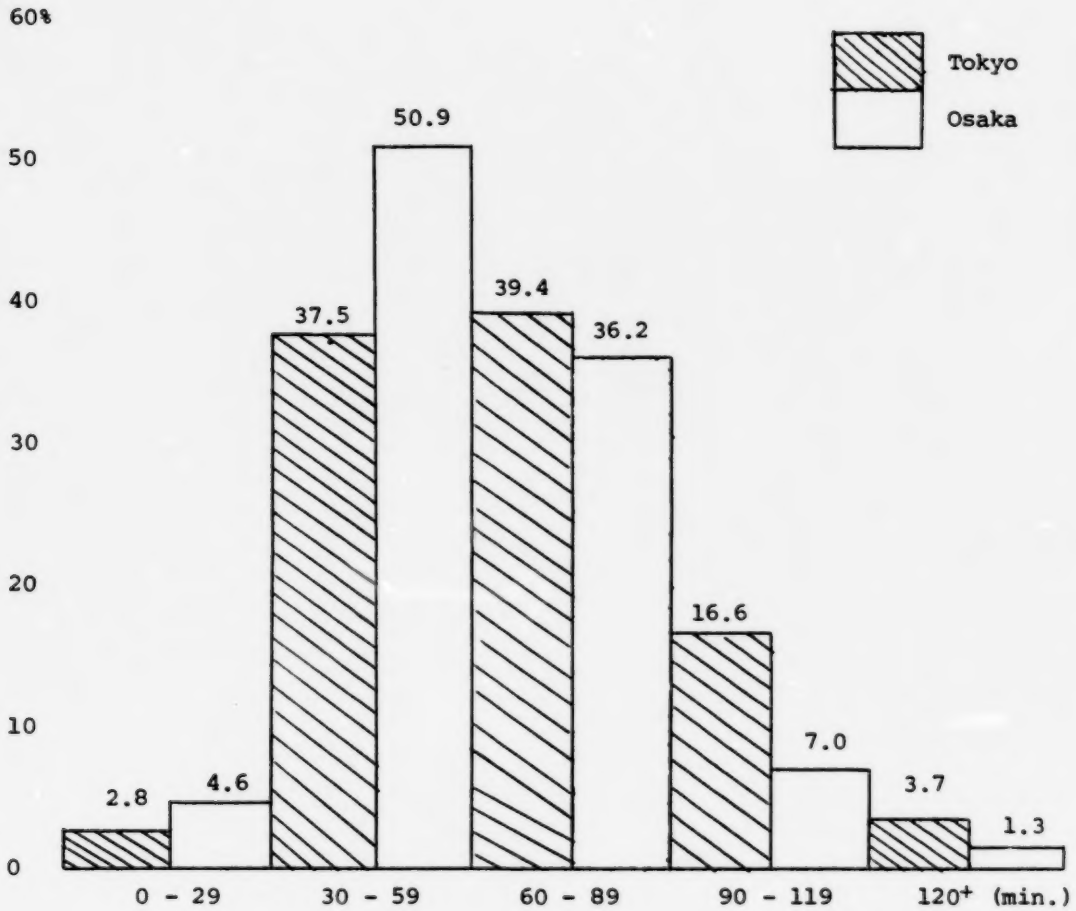
Change in the Land Price Index



Source: Real Estate Research Institute , 1983.

Table 2.4.3

Average Commuting Time for Tokyo and Osaka (1980)



Source: OECD Report, 1984 (unpublished).

Table 2.4.4

Standard of Housing

	Year	No. of rooms per house	Average size per house m^2	Average occupancy per house	Average lot size per detached house m^2
Nationwide	1958	8.6	---	---	---
	1968	8.8	78.9	3.96	290
	1978	4.5	80.3	3.47	299
Tokyo	1958	2.9	---	---	---
	1968	2.9	50.2	3.48	182
	1978	3.3	54.5	2.94	176
Osaka	1958	3.4	---	---	---
	1968	3.4	54.1	3.61	157
	1978	3.9	60.3	3.23	152

Source: Housing Survey of Japan, Bureau of Statistics, Prime Minister's Office, 1978 .

agricultural land to urban use, the extremely high price of any land, the financial burden of servicing new land, and the caution of local public bodies against accepting new development and the associated costs. As a result, some 85 percent of new single-family homes in urban areas are constructed on scattered in-fill lots, and 80 percent of these are owner-occupied sites. Home builders are most hesitant to inventory land or serviced lots, and, therefore, speculative housing is minimal.

2.5 Patterns of Residential Investment

In comparing elasticity of residential investment as a function of household income, house price, and mortgage interest rates between Japan and the United States, the elasticity of residential investment in the U.S. is higher on all counts. This suggests that the U.S. housing market is more sensitive to changing conditions in the economy and may be attributed to the following factors:

1. With the per capita housing stock of the United States being considerably higher than that of Japan, the priority of the house as a basic necessity is assumed to be lower for Americans than it is for Japanese.

2. Given the previously high rate of inflation in North America, homeownership appeals to Americans more as an investment to hedge against inflation rather than as a means to satisfy a housing need per se.

3. Sales of housing in the U.S. have come increasingly sensitive to the erratic movement of mortgage interest rates.

4. The ratio of house prices (including land cost) to the average income is lower in the U.S.

In Japan, the ratio of house prices (commercially supplied units plus land, 1979) to the average income (per household disposable income) is 16.0. This compares with the ratio of 10.3 in the United States (1979). On the other hand, the ratio of housing loans to the purchase price of a housing unit is higher in the United States (73.9 percent) than in Japan (60.4 percent), while the ratio of the housing loan to income is higher in Japan (9.7 times) than in the United States (7.4 times). Since the ceiling amount of housing loans is determined on the basis of the ratio of annual repayments to income, the elasticity of interest rates to the amount of loans is relatively low in Japan.

Although sensitivity of residential investment to changing economic conditions is lower in Japan than in the U.S., over the long and medium run this is expected to rise. The qualitative level of the housing stock has risen and the ratio of debt financing of residential construction has increased, both of which will contribute to increased elasticity in residential investment.

There are also significant differences in the behaviour of residential investment in Japan compared to the United States and Canada. The differences only began to emerge in the 1970s but will have longer term effects. One difference is the pattern of increase in the number of households. As households in Japan formed in the late 1960s and advanced in age to a generation requiring--and financially capable of acquiring--their own home, they helped bring about a boom in the construction of owner-occupied and supplied housing units in the second half of the 1970s. Judging from the present composition of the population, the number of household formations is likely to level off or decline.

On the other hand, the reverse seems to be true in the U.S., where marriages were on the increase toward the end of the 1970s. This explains the recent increase in residential construction in the 1980s, and, given the current composition of the population, the potential demand for single-family housing is expected to remain strong in the U.S. for some time to come.

Both countries have exhibited an increasing consumer preference for owner-occupied housing. In Japan, the demand may be divided into two categories: those households living in rental units and wanting to buy an owner-occupied house, and those households already living in an owner-occupied house but wanting to rebuild the existing unit or take the sale proceeds and purchase a unit in another location. Over the medium and long run, the number of households in rental units planning to purchase has remained virtually unchanged. However, as the ratio of owner-occupied housing has increased, there has been a corresponding drop in the ratio of nonowner-occupied housing. This, in turn, implies a relative increase among the ratio of renters planning to acquire a new owner-occupied unit.

Over the long run, residential investment in Japan will enter a stage where there is no longer a prospect of a rapid upsurge in building activity such as was witnessed during the period of rapid economic expansion of the early 1970s, if only because of a slowdown in the growth of population and household formation. However, given the increasing age of the existing housing stock, demand for rebuilding is projected to grow in a cyclical pattern. Factors conducive to a steady rate of residential investment are appearing, including a settling down of residential construction costs, a slowdown in the rise of land prices, and an improvement in real household income. Stabilization of interest rates also should have a positive effect.

2.6 Financing the New Home Purchase

It is evident that publicly financed house sales have gradually increased their share of new housing construction starts over the decades. This was caused mainly by the increase in construction of new houses financed by the Housing Loan Corporation (HLC). This trend has become even more visible since 1978 when increased financing by this public corporation was introduced as a measure to stimulate the economy. From 1972 through 1983, the percentage of publicly financed housing increased from 28.7 percent to 50.3 percent of total starts.

Public funding to increase housing supply can be divided into two categories: first, by direct public undertakings such as the construction of public housing supplied by the Housing and Urban Development Corporation and, second, indirectly through financial assistance to the prospective occupant. The latter includes owner-occupied houses financed by the Housing Loan Corporation and other public organizations. The number of owner-occupied houses financed by the HLC on which construction was started in 1982 reached 340,000. This represents more than half of all owner-occupied houses started in that year. Houses for sale by the Housing and Urban Development Corporation and the Local Housing Supply Corporation also encourage an increase in owner-occupied houses.

The Housing and Urban Development Corporation was established in 1981 as a result of a merger of the Japan Housing Corporation and the Housing Land Development Corporation. The Corporation started to construct houses in 1955 and through fiscal 1982 had supplied 430,000 houses for sale. For example, the Corporation planned to construct fifteen thousand houses for sale in 1982. These houses are eligible for long-term repayment schemes involving monthly payments on the

principal and interest amortized over thirty-five years. In this case, the term of the loan is for an initial ten years at 5.5 percent for a value equivalent to 50 m^2 or less of the total housing unit floor area. The remaining area is funded for the same term at a rate equivalent to the interest rate on the borrowings from the Treasury Loans and Investments Program Funds. This same rate also applies for the remaining twenty-five years of the Corporation's long-term special housing loan.

The Housing Loan Corporation was established in 1950 in response to the severe shortage of houses. It was intended to extend long-term, low-interest housing loans which banks and other institutions were reluctant to provide (table 2.6.1). The long-term, low-interest loans were to be co-ordinated with private housing loans to facilitate self-assisted acquisition of houses and to promote improvement in overall housing quality. For the construction of private detached housing by individuals in 1982, the HLC maximum loan was 6.2 million yen ($24,895 U.S.) for up to 110 m^2 and 6.5 million yen ($26,099 U.S.) for between 110 m^2 and 165 m^2 (U.S.$ = $249.05 yen). The maximum loan for land was 5.0 million yen ($20,076 U.S.). For units for sale that were built by local housing supply corporations, the loan amount was 80 percent of the total construction cost with a maximum size of 165 m^2. In both cases, houses built by individuals and houses built for sale by local housing supply corporations, the interest rate was 5.5 percent for houses less than 110 m^2 and 6.5 percent for 110-135 m^2; 7.3 percent for units 135-165 m^2 or for those with an income per year of more than 10 million yen ($40,152 U.S.). In each case, the rate went up to 7.3 percent after eleven years. Amortization was twenty-five years for wooden houses, thirty years for semidurable construction, and thirty-five years for fireproof construction. Principal and interest were required in the repayment schedule, and at the end of ten years there was the

Table2.6.1

Outline of the Housing Loan Corporation's Housing Loans
(for private individual's housing, rental housing, and improvement of housing)

Types of loans			Objects for which loans are to be made		Loan limits/% covered by loan	Interest rates	Term of repayment	Method of repayment
Private individuals' housing	Construction		Owner-occupied housing	House built by individuals	Construction cost Less than 110m²: ¥6.2 million More than 110m² but less than 165m²: ¥6.5 mil. Cost of land: ¥5.0 mil.	Less than 110m² 5.5% (7.3%) 110 - 135m² 6.5% (7.3%) 135-165m² or for those with income per year of more than ¥10 million 7.3%	Wooden within 25 yrs. Semi-durable w/i 30 yrs. Fire-proof w/i 35 yrs.	Principal and interests equally (optional: "step" repayment and/or take-over of loans.)
	For purchase	Units sold by local housing supply corp.		Units built by local housing supply corp.	Less than 165m²---80% of total construction cost	Funds to build units to be parcelled out (sold) Public housing corp. 5.5% (7.3%) Private 8.5%		
		Housing complex		Units built by private developers with approval by Housing Loan Corp.	Less than 110m²: ¥11.7 mil. From 110 - 165m²: ¥12.7 mil.			
		High-rise housing		Units to be sold by private developers in 3 metropolitan areas, etc.	Less than 110m²: ¥11.2 mil. From 110 - 135m²: ¥11.8 mil.	Less than 110m² 5.5% (7.3%) 110 - 135m² 6.5% (7.3%)	Fire-proof w/i 35 yrs.	
		Ready-built homes for sale		Housing development of less than ten units (ready-built houses)	Less than 110m²: ¥10.1 mil. 110 - 135m²: ¥10.7 mil.	For those with income per year of more than 10 million yen, 7.3%	Wooden within 25 yrs. Semi-durable within 30 yrs. Fire-proof w/i 35 yrs.	
	Pre-existing homes			*Pre-existing houses in 3 metropolitan areas, etc.	Less than 135m²: ¥7.9 mil.	Less than 135m² 6.5% (7.3%) For those with income per year of more than 10 million yen, 7.3%	w/i 20 yrs.	
Rental housing	Local housing supply corp.		Rental units supplied by local housing supply corp.		80% of total construction cost	Less than 120m² 5.5%	Semi-durable within 30 yrs. Low-rise fire-proof w/i 35 yrs. Medium and high-rise fire-proof w/i 50 yrs.	Principal and interests equally
	Rental units with land as collateral		Medium and high-rise rental units provided by individuals, etc.		99.45% of the total construction cost	Less than 120m² general 5.5% (7.3%) Special 4.5%	Fire-proof w/i 35 yrs.	
	Model rental housing		Low-rise rental units in specific areas provided by individuals, etc.		80% of the total construction cost	Less than 120m² 5.5% (7.3%)	Semi-durable w/i 30 yrs. Fire-proof w/i 35 yrs.	
Improvement of housing			Extensions, renovation or improvements of homes, etc.		70% of the cost or ¥3.5 mil.	5.5%	w/i 10 yrs.	Principal and interests equally (optional: can take over of loans)

Note: Interest rates in ( ) are rates after 11 years if this step-interest method is used.

*From Oct. 1981, detached wooden houses was included.

Source: OECD Report, 1984 (unpublished).

option of "stepping" up and/or taking over the loan privately.

More recently, the HLC has set upper limits on the housing unit floor space and on the value at which a house for sale is purchased. The Corporation has also employed an interest rate differential to be applied to loans, depending on income, size of house, etc. The HLC is currently involved in about 40 percent of all annual housing construction in Japan.

Private financing is available from various financial institutions, including banks, mutual banks, credit unions, and agricultural co-operative associations. Financial companies specializing in housing finance first appeared in Japan in 1971. Conditions of loans vary by institution. For example, city banks offer housing loans with the longest term (twenty years), an interest rate of 8.10 percent, and an annual repayment amount falling within 30 to 40 percent of the gross annual income. The size of the loan is restricted to 80 percent of value.

Government also promotes a savings incentive system and a special tax incentive system for housing that has no North American counterparts. Interest on a housing loan, unlike in the U.S.A. but similar to Canada, is not a tax deductible expense.

There are two kinds of savings systems. In one system, a person can receive a special public housing loan if a certain amount of money has been saved, that is, the Worker's Property Accumulation Savings System and the Housing Deposit in the Postal Savings System. In the other system, a person is given priority when purchasing a house being sold by a public corporation, that is, the Housing and Housing Lot Bond System of the HLC, the Acquisition of Housing for Sale by Reserve Fund System of the Local Housing Supply Corporation, and the

Special Housing Bond System of the Housing and Urban Development Corporation.

Companies and businesses may also extend housing loans to their employees at reduced rates of 4 to 5 percent, and these also fall under a provision of the special tax system on housing. The tax system offers various reduction and deduction measures applied to income tax, corporate tax, registration, and license taxes, as well as local taxes (table 2.6.2). These incentives were established to facilitate the acquisition of good quality owner-occupied housing, and, together with other financial systems for housing, the tax system is thus a key factor in Japanese housing policy.[4]

2.7 The Home Building Industry

In spite of major government involvement in the construction of housing in Japan that can be traced back to the temporary emergency houses of the war-ravaged cities immediately after the Second World War, the private sector has remained the dominant force in housing supply and government has never diminished a resolve to strengthen the role of the industry. However, it was only in the late 1950s, after the economy had recovered from the confusion of the prior decade and future growth in the economy was imminent, that the importance of modernizing housing production within the private sector was fully recognized. The background to the subsequent changes within the housing industry may be viewed from both the demand and the supply side.

---

4. OECD Report, 1984 (unpublished).

Table 2.6.2

Outline of Special Measures of Tax System for Owner-occupied and Rental Houses

Types of taxes	Special measures	Owner-occupied houses	Rental houses
Registration and license tax	Reduction of tax for ownership preservation registration for new houses	o	
	Reduction of tax for ownership preservation or transfer registration for new houses	o	
	Reduction of tax for establishing and registering collateral rights related to housing loans	o	
	Tax reduction for transfer registration of ownership rights of pre-existing houses	o	
	Reduction of tax for establishing and registering collateral rights related to loans for pre-existing houses	o	
Real estate acquisition tax	Special precedents and regulations on tax levels regarding new homes and newly acquired pre-existing houses	o	o
	Tax reduction on land used for new houses and pre-existing houses	o	o
Income tax	Exemption for house acquisition	o	
	Special precedents and regulations on loans at low interest rates provided by employers for their employees	o	
Income tax, corporate tax	Increased (or accelerated) repayments for newly built rental homes		o
Fixed property tax	Special precedents/regulations on tax levels regarding residential land (land intended for housing)	o	o
	Tax reduction for new houses	o	o
Income tax	Special tax deduction on transfer income of residential properties	o	
	Special precedents/regulations regarding tax for buying one house and selling another	o	
	Special tax precedents/regulations regarding buying land for construction of medium- and high-rise fire-proof apartments, in a pre-existing urban area, etc.	o	o

The traditional Japanese house and the trades associated with its construction have important historical as well as cultural roots that are every bit as influential today in shaping housing policy as those factors promoting modernizing of this industry. The traditional open-style construction may give way to the closed style of housing indicative of Western countries, but government and labour are not about to forfeit centuries of building skills that have honed carpentry to a fine art and refined post-and-beam construction to the level of cabinet making. It must be remembered that, while prefabricated housing is enjoying recent success in expanding from 10 percent to 15 percent of the total market, some one hundred thousand small builders continue to enjoy a major portion of the remaining 85 percent, many of whom, like their North American counterparts, are building four or five units per year.

On the demand side, the desire for better housing grew with the economic recovery through the 1960s and 1970s, and increasing stabilization through economic security began to aggregate demand in new markets. Furthermore, these new markets reflected demographic changes as the population continued to concentrate in urban areas and household size decreased. There was evident demand, both qualitative and quantitative, for housing in urban areas. But the traditional home tradesman did not necessarily follow this migration to the urban areas since his product was ill-suited to the dense and constricted conditions of the city. Wooden houses are a fire problem, and the open style of design which places emphasis on controlling the severe heat and humidity of summer weather cannot cope with the severity of other environmental conditions within cities.

On the supply side, technical innovations led to the mass production of new materials and the development of new construction methods, of which much was expected. These new

materials and methods could cope better with earthquake and fire problems, offer increased quality control, diminish reliance on wood imports, lower costs, and offer new amenities within the home. These innovations, in turn, led to changes in the structure of industry and employment patterns. The immediate consequence was a severe shortage of skilled labour in the housing industry amidst fast-growing markets for its products and a startling increase in annual housing starts. This was not a situation that the traditional house builder could cope with, at that time or in the foreseeable future.

These factors led government to examine housing supply and their own posture with respect to the housing industry and its future capability. The initial focus was on building materials and components and on the introduction of production procedures to increase the proportion of labour in the factory, rather than on site, and improvements in the productivity of these procedures to increase quantity and quality at lower cost. This was seen as an opportunity to promote modernization and rationalization of housing production generally and led to the technical development and sales of prefabricated houses by private enterprise by the early 1960s. Efforts by the private sector were complemented by actions in publicly managed housing to promote economies of scale through standardization and mass production of parts. These efforts included systematized designs and uniform standards as well as a standard parts system. This movement to industrialization was given further impetus by preferential financing to private enterprise by both the Housing Loan Corporation and the Japan Development Bank to promote industrialization of housing production.

Two major problems arose, each of which were to significantly influence consumer acceptance of industrialized housing and could, in the long run, offset any advantages to be gained on the supply side. First, there was an inclination to make

public housing the main market of medium-rise, industrially produced housing and, of course, the projects were carried out on limited budgets. These early examples were not the best demonstration of new technology and thus industrialized housing acquired the proverbial stigma. Second, there was a problem with the industrial production of detached houses by private enterprise. The ratio of on site versus factory work tended to increase, not decrease, as a result of attempts to assure high production volumes while meeting consumer demands for individuality and diversity. Factory-produced products were being hand tailored at the site in the tradition of conventional house building. For these reasons, the success of industrialized housing through the 1970s was not what was hoped for, and in spite of industry predictions of a market share of 20 to 30 percent the figure fluctuated around 10 percent right up to 1979.

It became clear by the 1970s that the expectations by both government and industry for industrializing and modernizing housing production were not justified by consumer demands. They had failed to realize that rapid economic growth had upgraded demands for housing beyond mere quantitative sufficiency to higher quality and diversity. Each family now sought their own "home"--an expression of individual identity, having enough diversity to reflect differing family composition and customs. This level of expectation was not readily achievable, however, as housing cost increases were occasioned by rising labour costs and prices for construction materials. Consumer dissatisfaction was further exacerbated by an insufficient stable supply of quality housing and the consequent housing deficiency problem. Promotion of industrialized housing production or the so-called prefab housing industry was not enough. It was necessary to promote the modernization and rationalization of the industry as a whole by such means as developing a system that incorporated the total housing supply structure and afforded adequate

consumer choice. This realization led to a whole host of policies and programs starting in the early 1970s to promote technical developments in everything from parts to production organizations, to introduce various types of authorization and certification systems, to create facilities for the education and training of construction engineers, and to establish various public service corporations to effect these measures.

The effectiveness of even these changes was brought into question by the end of the 1970s, and it was further recognized that policies which promote industrial production of housing, while effective for large-scale concentrated demand like that for public housing, were not sufficiently effective for the rationalization and modernization of housing production to meet the general demand for housing which is individualized and scattered. Even today, more than half of housing construction is done by small-scale businesses, carpenters and building contractors, using traditional Japanese construction methods and time-honoured distribution processes.

Deficiencies in the supply system were attributed to such factors as low technical standards, an insufficient labour force, and the unsystematic adoption of new materials and parts. Thus, simple mass production and an expanded role for prefabricated housing were not enough to meet this strengthened demand for individualized housing on scattered urban sites. New technologies to meet real versus perceived demands were required, the labour force who would use these technologies needed to be trained, and the social, economic, and organizational environments to support these technologies were required. Rationalization of the industry had to account for new technologies which could be used with an individualized and scattered demand and by small business enterprises such as local contractors.

Such measures are now being reflected in a number of new programs, including introduction of 2 x 4 construction (certified in 1979) and rationalization of traditional wood-frame housing. The introduction of 2 x 4 construction is not a technical development as such; rather, it is the adoption of the North American wood-frame system as one means of modernizing conventional wood-frame construction. Since its introduction and subsequent certification in 1979, 2 x 4 construction has enjoyed a steady growth, increasing some 10 to 15 percent per year. In 1983, 18,300 detached units were constructed using 2 x 4 platform construction, for a 1.7 percent market share. The importance of this construction is perhaps underscored by the interests of Mitsui and Mitsubishi, perhaps the two most prominent names in Japanese industry, who have launched exclusively into 2 x 4 residential construction.

In the midst of modernization and industrialization on the supply side and diversification and individualization on the demand side, the desire of many Japanese for traditional wood-frame construction housing remains strong. For this reason, technical development to rationalize traditional wood-frame housing and to promote research and training institutes for carpenters and building contractors is as high a priority with government as the prefab housing industry. Whereas housing is definitely not the priority of government that it was in the 1960s and 1970s, preservation of traditional wood-frame construction is a key government objective for a host of political reasons. Accordingly, new policy measures could well be taken in the later part of the 1980s, if the recent growth in the market share of prefab housing and 2 x 4 construction, the two competitors, were to seriously threaten the long-term viability of the traditional home builder.

3.0 GOVERNMENT POSTURE IN HOUSING

3.1 Five-Year Housing Programs

Modern housing policy in Japan originates with The Housing Construction Program Law enacted in June 1966. This law specified that the Minister of Construction draw up a five-year housing program starting in fiscal 1966 and based on a report submitted by the Housing and Building Land Council. The plan must be approved by the national Cabinet.

The law specified that national goals be set for all types of houses, including entirely privately funded and owned houses. Each prefecture must also draw up its own supplement to the national five-year program to reflect local conditions and special housing requirements. Since the law's inception, four five-year programs have been implemented (table 3.1.1). The first five-year program, between 1966 and 1970, provided 6.74 million houses in order to achieve the stated goal of "one house per household". The general goal of the second five-year program, 1971 to 1975, was to construct houses with "one room per person" and 8.28 million houses were built. In the third five-year program, 1976 to 1980, two important housing standards were established: the "minimum housing standards" (table 3.1.2) and the "average housing standards" (table 3.1.3). The program set about to enable every citizen to secure for themselves the minimum housing standards within ten years, or by 1985. At least half of the Japanese households were to achieve the minimum housing standards by the end of the third five-year program.

The program also sought to secure the average housing standards by 1985 for half of Japanese households, and both standards were again included in the fourth five-year program. A total of 7.7 million houses were constructed during the third five-year program, a fall from the projected figure of 8.6 million units.

Table 3.1.1

Comparison of the Four Five-year Programs 1971-75

	1st Program FY 1966-70	2nd Program FY 1971-74	3rd Program FY 1976-80	4th Program FY 1981-85
Overall Direction	1) Solutions to existing housing problems, particularly living-space problem. 2) Meet new demand caused by urban migration and rapid economic growth.	1) Continue to eliminate living-space problem. 2) Meet demand caused by post-war "baby boom".	1) Upgrade housing quality from a long-range perspective.	1) Continue to upgrade quality. 2) Meet need of post-war "baby boom" for owner-occupied homes.
Goals	Solve living-space problem. "One house per household."	Solve living-space problem. "One room per person."	"Minimum housing standards" to be secured for every person by 1985. (3.1.2) Half of households below standards to be eliminated. "Average housing standards" to be secured for every average household by 1985. (3.1.3)	Continue with minimum and average housing standards. "Residential Environmental Standards."
Total Units to be Constructed (1,000)				
Forecast Total	6,700	9,576	8,600	7,700
Publicly Financed	2,700 (40.3)	3,838 (40.0)	3,500 (40.7)	3,500 (45.5)
Actual Total	6,739.3	8,280	7,697.5	
Publicly Financed	2,565.3 (38.1)	3,108 (37.5)	3,648.5 (47.4)	

Source: OECD Report, 1984 (unpublished).

Table 3.1.2

Minimum Housing Standards

Number of household members	Rooms composing the dwelling unit	Floor space of dwelling rooms	Net floor space per dwelling	Gross floor space per dwelling (Including space for common use,etc)
1	1 K	7.5m² (4.5 *tatami*)	16 m²	(21m²)
2	1 D K	17.5m² (10.5 *tatami*)	29 m²	(36m²)
3	2 D K	25.0m² (15.0 *tatami*)	39 m²	(47m²)
4	3 D K	32.5m² (19.5 *tatami*)	50 m²	(59m²)
5	3 D K	37.5m² (22.5 *tatami*)	56 m²	(65m²)
6	4 D K	45.0m² (27.0 *tatami*)	66 m²	(76m²)
7	5 D K	52.5m² (31.5 *tatami*)	76 m²	(87m²)

Notes

1. A standard household here refers to a family consisting of the husband, wife, and a child or children who sleep separately from other family members. In a family of five members or more, however, it is assumed that two of the children share one bedroom.
2. "Floor space of dwelling rooms" includes only bedroom or bedrooms and dining room combined with kitchen.
3. "Net floor space per dwelling" includes bedroom or bedrooms, dining room combined with kitchen, toilet, bathroom, storage room, etc., but does not include the space for common use nor the balcony in an apartment house.
4. The numeral in the codes in the column of "Rooms composing the dwelling unit" indicates the number of bedrooms, "K" the kitchen, and "DK" the combined dining room-kitchen.
5. "Gross floor space per dwelling" includes the space for common use in a stair-hall type medium-storied house and the space for the balcony. (However, only one half of the balcony space is included.)

Source: Housing in Japan, Housing Bureau, Ministry of Construction, 1980.

Table 3.1.3

Average Housing Standards

Number of household members	Rooms composing the dwelling unit	Floor space of dwelling rooms	Net floor space per dwelling	Gross floor space per dwelling (Including space for common use,etc)
1	1DK	17.5m² (10.5 *tatami*)	29 m²	(36m²)
2	1 LDK	33.0m² (20.0 *tatami*)	50 m²	(60m²)
3	2 LDK	43.5m² (26.5 *tatami*)	69 m²	(81m²)
4	3 LDK	57.0m² (34.5 *tatami*)	86 m²	(100m²)
5	4 LDK	64.5m² (39.0 *tatami*)	97 m²	(111m²)
6	4 LDK	69.5m² (43.5 *tatami*)	107 m²	(122m²)
7	5 LDK	79.5m² (48.0 *tatami*)	116 m²	(132m²)

Notes

1. "A standard household" here refers to a family consisting of the husband, wife, and a child or children who sleep separately from other family members. In a family of five members or more, however, it is assumed that two of the children share one bedroom.
2. "Floor space of dwelling rooms" includes only bedroom or bedrooms and dining room, kitchen (or combined dining room-kitchen) and a living room.
3. "Net floor space per dwelling" includes bedroom or bedrooms, dining room, kitchen (or combined dining room-kitchen), toilet, bathroom, storage room, etc., but does not include the space for common use nor the balcony in an apartment house.
4. The numeral in the codes in the column of "Rooms composing the dwelling unit" indicates the number of bedrooms, "L" the living room, "D" the dining room, "K" the kitchen (in the case of single persons, however "DK" shall indicate a combined dining room-kitchen).
5. "Gross floor space per dwelling" includes the space for common use in a stair-hall type medium-storied house and the space for the balcony. (However, only one half of the balcony space is included.)

Source: Housing in Japan, Housing Bureau, Ministry of Construction, 1980.

The fourth five-year program, approved by Cabinet in March 1981, is almost complete and represents not only a continuation of programs started in the third and fourth plans, notably to improve residential standards, but also seeks to stimulate the supply of owner-occupied housing and the overall level of residential construction activity. The fourth program contemplates construction of 7.7 million units, of which 5.5 million units or 71.4 percent will be owner-occupied housing, the remainder being rental units. The public sector will finance 3.5 million of these units, or 45.5 percent, continuing an almost even split between publicly financed and privately financed units.

Features of the fourth five-year plan include increased aid for housing acquisition through an increase in the HLC loan amount, expansion of the eligible floor space for HLC loans, and increased incentives through the tax system. New emphasis is placed on using existing stock and programs to expand or remodel this stock, essentially through the application of the same HLC loan features and tax incentive systems to existing houses. An emphasis is being placed on increasing housing supply in urban built-up areas to repopulate urban areas and reduce commuting times (this applies principally to medium and high rise housing) and upgrading wooden rental houses in these same areas.

Modernization of housing construction is a particular feature of the fourth five-year program, and this policy has had a measurable impact on the recent successes of industrialized housing in the 1980s. The following measures were sought by government through various programs and incentives available to the industry:

1. introduction of factory production methods to increase factory versus on-site labour;

2. development of new construction methods, such as represented by House 55;[5]

3. introduction of approval systems to recognize excellence in the quality of housing products and houses constructed by factory production methods;

4. rationalization of traditional wooden house construction;

5. popularization of the 2 x 4 method of wood-frame construction; and

6. standardization of housing designs.

It became evident to the government during the fourth plan that housing-related industries had been put under extremely severe financial hardship due to the downturn in residential construction in the early 1980s. Government realized its immediate task was to support these industries and introduced new programs to implement this policy. Measures taken to redress problems related to the housing industry included:

1. lowering construction costs through a reduction in material production costs and more efficient distribution systems for housing products;

2. offering better protection to the house purchaser by supplying more precise information on quality, modernizing the house-related markets, and strengthening the post-sales service system for the consumer;

---

5. See 3.2, Promoting Industrialization in Housing, for information on House 55.

3. introducing rigid guidance for the industry to eliminate "defective housing" due to mistakes in design and construction;

4. promoting measures for the increased restraint in the use of resources and energy, including more effective and efficient use of land;

5. upgrading the functional aspects of the house in order to meet new demands for increased space, better arrangement of rooms, improved equipment standards, soundproofing and durability, and the needs of the aged; and

6. developing renovation methods as well as reorganization of the housing industry to properly satisfy new demands for extension, rebuilding, and remodelling of existing houses.

The Japanese government recognized the necessity to stimulate and improve the capacity of the housing industry, that is, the supply side, through direct action as a complement to various indirect means to increase demand. The fourth program clearly stated that "in order to secure a stable and smooth supply of good and properly priced houses which meet the needs of people, it is necessary for the government to positively direct and develop the housing industry as part of the housing policy of the government". Specific objectives emanating from such a policy provided strong implications for industrialized housing, namely:[6]

---

6. OECD Report, 1984 (unpublished).

1. For producers of factory-made houses and housing parts, standardization of parts and quality of houses is to be further encouraged and thus the rationalization of production is to be made with the use of the approval system on the quality of factory-made houses and good housing parts.

2. In order to meet the advanced and diversified needs of people for houses under the new social and economic conditions, it is essential to develop new techniques for the design and construction of houses. It is also necessary to guide and direct the housing-related industry toward the development of these techniques. For this purpose it is important to make guidelines indicating the direction of the development, and guide the industry for the development of high technology which has a large spreading effect and urgency for application, thus raising the living standard and stimulating the housing-related industry.

3. It is important to organize a housing-related market and stimulate the housing industry by providing appropriate information on the quality and on the post-sales service system of houses and housing parts for purchasers and residents of houses. For this purpose, approval systems on the quality of housing parts and factory-made houses are to be expanded and strengthened; more precise information is to be provided for consumers; a quality guarantee system to be strengthened and a quality indicating system for medium and high rise apartment buildings to be established. By spreading the guarantee system of the house quality, long-term guarantee systems of houses are to be reorganized; protection of consumers is to be strengthened; and the development of housing-related industries is to be stimulated.

Present housing policy not only addresses new housing but also recognizes the need to maintain, manage, and improve existing housing stock. The search for improved housing quality among existing stock covers extension, remodelling, and renovation along with improvement of the used housing distribution market. Government measures in this regard have furthered the role of industrialized housing producers and include:

1. expanding loans through the HLC for renovation and remodelling;

2. developing the potential demand for renovation and remodelling through advertising that informs homeowners of the significance, methods, and procedures for upgrading their current homes;

3. training and educating specialists who can serve as renovation consultants to consumers;

4. promoting new technologies related to renovation and remodelling, establishing a rational system for execution of the work, and standardizing methods of calculating costs for such work;

5. establishing an information supply system for used houses and a consolidation of the market for such houses; and

6. expanding public loans for the acquisition of used houses.

3.2 Promoting Industrialization in Housing

No doubt government has played a key role in rationalizing housing production and supply, and this has involved two distinctly different ministries: the Ministry of Construction (MOC) and the Ministry of International Trade and Industry

(MITI). Technological advancements in housing production and supply have been promoted by both MOC and MITI through such programs as:[7]

1. The New House Supply System (House 55) Development Project was jointly sponsored by MOC and MITI and actually began in the third five-year plan, fiscal 1976. "House 55" was designed to supply houses starting in 1980 (or year 55 of the Shawa era) having a total floor space of 100 m^2 and selling for 5 million yen (1975) or twice the average household income in 1975. The objective was to meet the demand for "good-quality, low-cost housing". The first units reached the market in 1982, and 10,000 units of House 55 were produced by May, 1984.

2. The Technology Development Project of New Materials and Facility Systems for Apartments started in fiscal 1984.

3. The Housing Project 85 was started in fiscal 1983 to establish a system of production and supply of good-quality, low-cost wooden houses constructed by conventional methods.

4. The Wooden House Promotion Model Project has been carved out since fiscal 1980 for the purpose of supplying good-quality wooden houses appropriate to the different regions of Japan.

---

7. OECD Report, 1984 (unpublished).

5. The Project for Promoting the Advancement of Housing Functions started in fiscal 1980 to guide and promote the development of urgently needed housing-related technologies. For example, a highly durable housing system called The Century Housing System was developed in this project and promoted through favourable loan conditions from the HLC.

6. The New Housing Technology Development Project was also started in fiscal 1980 to promote the development of housing-related technologies.

7. A system called The Industrialized Housing Performance Approval System has been implemented since 1973. In this system, MOC approves the performance of various types of industrialized houses. About sixty types of houses have been approved thus far.

8. For the same purpose, another system called The Excellent Housing Parts Approval System has been implemented since 1974. MOC approves housing components (twenty-seven items including kitchen units, hygiene facilities, bath units, aluminum sashs, etc.) which excel in quality, performance, and after-sale service and durability (1,200 types of housing parts have been approved thus far).

9. The Warranteed House System aimed at consumer protection, assurance of quality, and post-occupancy service through special long-term warranty is now being introduced throughout the country.

10. The Performance Specification System, a new system stipulating performance standards for condominiums, is now being studied.

11. The Acknowledgement System of Factories with Good Quality Control for Prefabricated Houses and Other Articles was started by MITI in fiscal 1972. In this case, MITI approves the factories with good quality control systems and seventy-three factories have been approved thus far.

Three projects are now underway to encourage energy conservation in housing:[8]

1. The Development of Energy-Efficient Housing Systems, a comprehensive technological development project for research and development of housing structures and facilities that exhibit energy conservation.

2. The Development of Passive Systems for Energy Conservation, based on the use of solar heat.

3. The Development of Energy-Efficient Multi-Dwelling-House-Design Plan System is presently underway to implement comprehensive energy conservation measures in multidwelling houses.

3.3 Ministry of Construction (MOC)

The Ministry of Construction (MOC) covers a vast territory, of which housing is only one part. It has a hand in almost every sector and location in the country where construction is involved. MOC's budget accounts for 68 percent of the total national budget for public works and 39 percent of its budget is allocated to housing. Responsibilities range from administration of the land and housing supply, urban planning functions, administration of rivers, roads and government buildings through to supervision of the construction industry

---

8. OECD Report, 1984 (unpublished).

and promotion of international co-operation through provision of technical and financial aid. A key role is its responsibility for preparing the Five-Year Housing Construction Program, as well as exercising supervision over such public authorities as the Housing and Urban Development Corporation and Local Housing Supply Public Corporations. It also enforces the necessary regulations controlling private real-estate agents and building contractors. Auxiliary organs include the Building Research Institute, the Construction College, and various building councils and construction bureaus.

The omnipresence of the MOC in all facets of the construction industry in Japan has not only provided MOC with a comprehensive view of the housing industry, both from a demand and supply perspective, but has allowed it to forge strong bonds with industry and move into programs in direct support of industry initiatives. That is not to say, however, that such bodies always work in close harmony toward a single, well-understood objective. Neither do the Japanese believe in bureaucratic miracles.

It is the centralization of the responsibility to formulate housing policy and the means and resources to implement such policy through an omnibus agency such as MOC that distinguishes the Japanese style of government intervention from its Western counterparts. Both Canada and the United States must deal with a host of fragmented ministries, departments, agencies, and quasi-public corporations when dealing with the housing problem, and our governments would be alarmed at the vesting of such powers within a single body, irrespective of their political adversity to specifying national policy programs with a five-year life span.

3.4 Ministry of International Trade and Industry (MITI)

Any focus on economic direction and control in Japan will be upon the Ministry of Finance and the Ministry of International Trade and Industry. Finance is the budget-making agency; it has extensive powers over macroeconomic policy, and it is the co-ordinating ministry for those other agencies with economic responsibility. It shares with MITI numerous responsibilities for microeconomic policy, and many of the major instruments of economic decision-making are lodged in part, or in whole, in these two ministries. The other ministries and agencies are charged with administering economic policy, as is the case with the Ministry of Construction.

The role of MITI in guiding Japan's economic and industrial growth, particularly over the past several decades, is now legendary. The mystique of MITI has been debated in numerous books, and it is clear that the United States, for example, could never have a comparable agency freed from the constraints imposed by congress, the courts, and special interest groups. MITI is one of those comparatively rare service institutions that has achieved effectiveness in whatever it does, and not just in implemented programs. The housing industry, as with most every other industrial sector, has not escaped its influence, and MITI's role in improving the quality and effectiveness of housing production in Japan has no equivalent in any other advanced industrial democracy.

The key characteristics of MITI are its small size (the smallest of any of the economic ministries), its indirect control of government funds (thereby freeing it of subservience to the Finance Ministry's Bureau of the Budget), its "think tank" functions, its vertical bureaus for the implementation of industrial policy at the micro level, and its internal democracy. To find comparable achievements by government bureaucracies in other nations, one would have to

look to cases like the wartime Manhatten Project in the U.S. or NASA's achievements in sending a manned craft to the moon. Therefore, it is not surprising to discover that Japan's industrialized housing success has a great deal to do with MITI, or vice versa, since MITI first entered the housing field in 1969.

It was some fifteen years ago, when the U.S. was beginning to recognize the demise of Operation Breakthrough,[9] that MITI established a small section with responsibility for the housing industry. Prior to this date, it had conducted policy on housing-related industries in a fragmented fashion, looking at bathroom fixtures, new materials, or housing components. This new division was prompted by the dramatic increase in housing starts throughout the 1960s and the expectations of even greater growth of housing demand in the 1970s (the peak in residential starts occurred in 1972). It was obvious to government that the existing housing industry, comprised of fragmented building trades and a preponderance of small companies, could not meet the escalating demand.

MITI's response was to apply industrial methods to housing production. It was decided that the housing industry, or at least a segment of the industry, should follow in the footsteps of the automobile and electronics industries. This was the necessary impetus to secure for government a direct role in promoting industrialized housing and the application of new technologies to improve overall housing quality. The first evidence of MITI's involvement was The Acknowledgement System of Factories with Good Quality Control for Prefabricated Houses and other Articles, started in fiscal 1972 (1971).

---

9. See 6.1, A Paradigm for Success, for information on Operation Breakthrough.

This was followed shortly thereafter by a joint effort of MITI and MOC to promote a lower cost house through the advancement of new technologies. The results of The New House Supply System (House 55) Development Project launched in fiscal 1976 (1975) represented the first comprehensive technological development policy in housing production in Japan. Following House 55, MITI launched its own housing research projects, independent of MOC, and in 1980 embarked on a five-year program of research and development of five areas:

1. A basement system for detached houses in response to the land-cost problem and as a means of achieving greater gross floor area on a restricted lot size.

2. Facilities to increase the mobility and functioning of the handicapped and elderly in the home in response to the aging of the population.

3. Systems of passive solar energy to reduce dependency on fossil fuels in response to the oil shocks that had threatened the Japanese economy in the 1970s.

4. The expandable house based on a concept of adaptability that could accommodate changing family composition and living styles.

5. Chemical treatment of wood to increase durability and longevity in response to the distinct preference of Japanese house purchasers for wood construction.

These projects are scheduled for completion in 1985, and the first evaluation of the results is contemplated in March, 1986. The second set of research topics is now underway, with the emphasis on new technical developments that could redress a number of problems with existing buildings, particularly problems with the large apartment blocks or "mansions" built

in the 1960s and 1970s that now exhibit severe structural deterioration as well as the commonly expressed environmental problems. The following projects were started in 1984:

1. Systems and devices to examine the present structural integrity of high-rise buildings without damaging the structure. This is in response to perceived problems of durability in these buildings and the differential rates of deterioration among various building components that is making rehabilitation efforts difficult and costly.

2. New insulation materials to prevent moisture problems and noise transmission problems in these buildings.

3. Efficient use of water involving the separation of potable water from "grey water systems" and the recycling of the latter in large apartment blocks.

4. Efficient generation of energy, particularly from sunlight, through development of a fuel cell. This project is being carried out in co-operation with Energy and Natural Resources.

These projects are research promoted and funded by government but carried out by industry. Government's role in funding research in Japan is still far below that found in Western nations, and, in fact, the percentage financed by public funds is the lowest of any large industrial country in the world. The lack of expenditures in military research may well account for this figure, but, on the other hand, it may give evidence of the quality and direct applicability of Japan's research and development in comparison to countries with substantial military research spending. In 1982, 23.6 percent of Japan's research was publicly funded and total research expenditures represented 2.78 percent of the national income. Government funding of research was double this figure in the United

States, 46.7 percent, and total research expenditures were 2.86 percent of the national income.

While the centralization of powers in both MOC and MITI may be unique to Japan, co-ordination among public agencies and government ministries in Japan is no less difficult than in our own countries. It is clear that the experience with House 55 did little to forge a close working relationship between MOC and MITI, and it now appears each would prefer to go their own way in subsequent research endeavours. Loyalties within each ministry often lead to sectionalism of perhaps a more rigid kind than normally found within Western bureaucracies, and there is evidence of not only competing claims and interests among these two ministries but a jealous guarding of their respective prerogatives in the housing field.

3.5 Japan Development Bank (JDB)

Government support for housing producers can be seen in the level of funding provided by the Japan Development Bank for equipment and factory loans (table 3.5.1). This bank's loan program to the housing industry started in 1968 (the JDB was incorporated in 1951). The loan program was in response to the need for new equipment and machinery to meet the forecasted demand in the first five-year program (fiscal 1966) and was not restricted to prefab companies. The heavy demand as evidenced by residential construction starts in the late 1960s and early 1970s seemed to justify the loans. In turn, government was pleased with its new initiatives in support of the housing industry, and the Japan Development Bank continued to act accordingly.

In the period 1968 to 1969 actual loans for equipment and machinery to the prefab housing industry were 370 billion yen. There was a dramatic increase in the period 1970 to 1972 to

Table 3.5.1

Loans by the Japan Development Bank (billion Yen)[1]

	1968-69	1970-72	1973-75	1976-78	1979-81	1982-85	Total
Concrete prefab	370	3,880	1,720	200	0	0	6,170
Wood prefab	0	180	640	0	0	0	820
Steel prefab	0	1,420	3,030	270	590	500	5,810
Totals	370	5,480	5,390	470	590	500	12,800

Source: Japan Development Bank, 1984.

1. For plant and equipment to prefab housing companies.

5,480 billion yen, and this was matched again in 1973 to 1975 with 5,390 billion yen. For the periods 1976 to 1978, 1979 to 1981 and 1982 to 1985, loan amounts were lower at 470 billion, 590 billion, and 500 billion yen, respectively. Total loans from the JDB to the prefab industry totalled 12,800 billion yen from 1968 through 1984.

After 1975, the reduction in loan amounts reflected, in part, the first oil shock, but to some extent the slowdown in starts was inevitable--demand could not justify the continued high rate of funding through the 1970s and 1980s. Loans made in the early 1970s may have been sufficient to provide an appropriate capacity for the prefab industry, and this capacity, even today, may be sufficient to meet future demand.

3.6 Current Posture on Housing

Housing problems in Japan today do not receive the high profile that they once enjoyed in the 1960s and 1970s, and the government's housing budget has been decreasing both in real value and as a percentage share of total government expenditures. Annual housing starts are well within the production capacity of the housing industry, and, if any action by government is required, it will likely be to stimulate demand as annual housing starts show a possibility of further decline.

There is a shift in government housing policy away from the house per se toward problems associated with the environmental setting for the house and specifically the perceived deterioration of living environments within the metropolitan regions. There is a genuine concern that, if the present situation continues to be aggravated, these urban districts will lose their attractiveness as residential environments and cause an accelerated migration to new outlying areas with

attendant costs of roads, sewers, and services. Programs are being launched for the comprehensive improvement of specific residential areas by local governments, and incentives are being offered to the private sector to increase both the supply and quality of housing in these inner areas. These programs are being combined with a major emphasis on the reuse of existing housing stock of all types and replenishing of deteriorated housing stock.

New technical developments are being focussed on problems with the massive residential apartment blocks or danchi that were built as government-sponsored rental housing on the periphery of metropolitan centres. Although these buildings are not old, they have not aged well, and solutions to technical failures, as well as upgrading the environmental quality of these complexes, will be a key focus of government and, in particular, the research programs under the auspices of MITI.

4.0 INDUSTRIALIZATION IN THE HOUSING INDUSTRY

4.1 Prefabricated Housing in Japan

Industrialized housing in Japan is referred to as "prefabricated housing" or, more commonly, "prefab housing". The term is somewhat broad and covers all components manufactured in a factory for on-site assembly, including the structural members of wood-framed houses, reinforced concrete and concrete block reinforced structures, steel-frame structures, and reinforced concrete and steel-frame structures. The term "prefab housing" in the single detached field is used to distinguish factory-built housing from traditional on-site Japanese wood construction and 2 x 4 construction. The term "prefab" now applies to some 15 percent of total housing starts.

Prefabricated houses have a long tradition in Japan, and although the idea was first introduced in Europe there is a record of experimentation in Japan dating back some fifty years. In 1919, materials using precast concrete were exhibited in the Ueno Peace Exposition. It was not until after the war, when faced with the formidable task of rebuilding Japan, that prefabrication became a serious endeavour. In 1946, a wood-panel assembly house was put on the market (Premose) and one thousand units were constructed that same year. In 1948, Nihon Precon started the construction of public houses with precast concrete components, and this was followed in 1953 with the production of aluminum window sash. Interest continued to flourish both within industry and within government. As with so many of Japan's industrial accomplishments, government had a direct and continuous hand in promoting prefab housing, dating as far back as the earliest attempts to establish it.

It took only until 1955 for Japan to recover its prewar industrial production levels, and perhaps this rapid rate of recovery should have been a portent of things to come. Certainly, the demands of the Korean War accelerated this process, and the rate of recovery provided industry and government alike with a new found confidence with which to confront the high-growth period that lay ahead. In 1955, ten million tons of crude steel were produced, and lightweight steel frames came on the market for housing application for the first time. In the same year, the Japan Housing Corporation was established and became the client for widespread use of the tilt-up method for large precast concrete panels developed jointly by the Construction Research Center of the Minister of Construction and Taisei Construction, a private firm. This method was used for public housing under the sponsorship of the Japan Housing Corporation and was given further impetus from favourable loan programs offered through the Housing Loan Corporation.

In 1955, Daiwa House Industrial was established and produced a small pipe-frame unit for outdoor storage. This was followed in 1959 with a small house manufactured from light gauge steel, called the "Mizet", that could be added to the rear of the existing house as a study room for children or an extension for grandparents. Other companies soon followed, including Sekisui, Matsushita Denko (National), Yawata Ekon, and NK Prefab. These companies also relied on relatively low-cost light gauge steel produced by such companies as Yawata Seitetsu and Nippon Kokan to develop steel-type prefabricated houses.

In 1962, a lumber company developed and put on sale a prefabricated house with modular wooden panels under the name "Misawa Homes". One year later, in 1963, the Japan Prefabricated Construction Supplies and Manufacturers Association was founded by manufacturers of prefabricated

houses and construction materials. Founding membership included thirty-eight regular members (manufacturers) and twenty-six associated companies (suppliers).

Strong policy guidance for the prefab industry in its formative years came from the Ministry of Construction through three major instruments:

1. The Housing Loan Corporation established in 1950 to provide long-term low-interest loans from the national treasury at a time when housing construction was in a state of decline due to lack of private loans.

2. The Publicly Operated Housing Law, enacted in 1951, provided subsidies by the national government to local public bodies and public corporations for the construction of low-cost rental accommodation.

3. The Japan Housing Corporation was established in 1955 to meet the extensive demand for housing within the metropolitan areas. This corporation was later combined with the Housing Land Development Corporation in 1981 and renamed The Housing and Urban Development Corporation.

Government support was first directed at increasing the overall housing supply and not just through prefab housing. But it became readily apparent that required annual production rates could not be achieved by traditional building methods, and prefabrication was sought as a means to increase these levels. However, consumer resistance to prefab was a major barrier due to lack of familiarity with the product and particularly with the quality of prefab construction in comparison to the long-established methods of traditional wood construction with its exquisite carpentry. The Housing Loan Corporation went as far as to offer special incentives in the form of increased loan support for the purchase of privately

built prefab houses to show open support for the prefab industry.

The rapid rise in housing starts in the late 1960s and early 1970s brought with it numerous new entries into the prefab field, and there seemed to be an unfounded rush to construct new factories by firms not previously associated with housing construction. No doubt this was fuelled by government policies that reflected a general concern with the ability of the existing housing industry to meet the rate of housing starts that was evident right up to the first oil shock. Many, if not most, of those fledgling companies are now out of business and their remnants absorbed by those who were fortunate enough to survive.

As one example, a major dairy producer in Japan, flush with the success of its new yoghurt product, ventured into the prefab business in the early 1970s. Success in dairy products was seen as an opportunity upon which to diversify into housing and cosmetics, and a licence agreement was entered into for production of a modular unit developed in the United States. The venture failed, and the company joined a general retreat from the field of prefab housing. Toyota was also an early entry and has endured, although its expectations for diversification into housing in the 1970s were never fully realized. Fearing that the automobile market had matured, the company looked at more promising areas for its manufacturing expertise. After a lengthy period of adjustment, Toyota has renewed its push in prefab housing but at a production level far below that of the top five. The prefab industry today is relatively stable, and it is unlikely that new entries will challenge the current survivors and their dominant market shares.

During the high growth period, and in spite of the optimism of government and industry alike, the prefab industry was unable

to gain much more than 10 percent of all housing starts through the 1970s. This was far short of their initial predictions of a 20 to 30 percent share by 1978. It was not until the subsidence of direct government support for the industry and the consolidation of the industry in the hands of the top five companies that the prefab housing industry seems to have flourished (table 4.1.1). What made this success more significant was its coincidence with a reduction in housing starts. In its infancy, during the period 1962 to 1965, prefab housing represented only 2.3 percent of total starts. This rose to 10.60 percent in the period 1971 to 1975 but never got above 11 percent in the last half of the 1970s. However, the next four years were critical growth years that perhaps signified a new trend. The market share for prefab housing stood at 15.3 percent in 1983, 173,939 starts of a total of 1,134,867. Some industry projections see this increasing up to 30 percent in the next decade.

4.2 Current Status of the Industry

The prefab housing industry in Japan is dominated by a handful of companies to an extent that is seldom found in industrial sectors outside the automobile industry. Major success in the industry now rests with just five producers. In 1983, these five companies accounted for 80.5 percent of all prefab starts in detached housing units (73,485 starts), and the top ten prefab companies garnered 93.7 percent of detached prefab starts (85,536 starts, table 4.2.1). In direct contrast to the traditional home-building industry, which has some one hundred thousand contracting companies building homes, prefab housing construction seems to be a segment where only a few very big companies can survive. This concentration in the hands of the top five is solidly ensconced and there is little likelihood of displacement by one of the remaining companies in the top ten list. The top five have retained their same ranking for a number of years, although there has been

Table 4.1.1

Prefab Production by Unit Type (%)

	1971	1975	1979	1980	1981	1982	1983
Detached	73,130	91,011	87,291	90,275	87,572	96,599	91,303
	(53.8)	(55.5)	(54.4)	(59.2)	(56.3)	(58.1)	(52.5)
Low-Rise Apartment	10,941	23,063	44,555	35,942	38,299	43,112	55,688
	(8.0)	(14.1)	(27.8)	(23.6)	(24.6)	(25.9)	(32.0)
Middle-High-Rise Apt.	51,768	50,055	28,651	25,766	29,570	26,637	26,948
	(38.1)	(30.5)	(17.8)	(17.2)	19.1)	(16.0)	(15.5)
Total Production	135,839	164,129	160,497	151,983	155,441	166,348	173,939 (100.00)
Market Share (%)	8.4	10.9	10.75	12.6	13.6	14.4	15.3

Source: Building Center of Japan, 1984.

Table 4.2.1

Prefab Production of Detached Units by Company

	1978	1979	1980	1981	1982	1983	
1.	Misawa	→	→	→	→	Misawa	
	20,797	21,284	23,669	21,312	25,039	26,289	
2.	Sekisui House	→	→	→	→	Sekisui	
	18,678	21,211	20,766	20,004	20,662	18,143	
3.	Diawa	→	→	→	→	Daiwa	
	9,568	9,381	11,223	11,624	12,145	10,127	
4.	National	→	→	→	→	National	
	8,493	8,338	9,196	8,745	9,969	9,772	
5.	Sekisui Chemical	→	→	→	→	Sekisui	
	7,412	8,300	8,719	8,335	8,876	9,154	
6.	Toshiba	Asahi Chemical	→	→	→	Asahi	
	2,484	2,933	3,744	4,520	4,929	4,883	
7.	Tessei	Toshiba	Taisei Const.	→	→	Taisei	
	2,451	2,104	3,493	3,001	3,069	2,721	
8.	Asahi Chemical	Tessei	Kubota	Toshiba	Kubota	Kobori	
	1,954	1,569	1,483	1,743	1,757	1,604	
9.	Kubota	→	Nisseki	Kubota	Kobori	Nisseki	
	1,478	1,510	1,353	1,516	1,589	1,431	
10.	Nisseki	Kobori	Kobori	Nisseki	Toshiba	Kubota	
	1,358	1,016	1,181	1,123	1,586	1,412	
	64,948	68,514	73,573	70,029	76,691	73,485	TOP 5
	(77.0)	(78.5)	(81.1)	(80.0)	(79.3)	(80.5)	
	74,673	77,646	84,827	81,932	89,621	85,536	TOP 10
	(88.3)	(89.0)	(94.2)	(93.6)	(92.6)	(93.7)	
	84,375	87,291	90,725	87,572	96,599	91,303	OVERALL
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	
							% OF SFD STARTS

Source: Building Center of Japan, 1984.

considerable ranking adjustment of the next five companies on the list.

The ranking of the top five for detached housing units differs from the ranking for overall production of prefab units due to the variations in production of low-rise multifamily units across the five companies (table 4.2.2). Over the past five years, there has been a slight decline in detached starts and a corresponding increase in low-rise multifamily starts. There also has been a decline in high-rise prefab starts, but this has a negligible effect on the top five producers. Sekisui House traditionally has been the most aggressive of the top five in the low-rise apartment market and is the only prefab producer with production of apartment units (22,293) now exceeding detached units (18,143 units, table 4.2.3). Misawa, the largest producer of detached units (26,289 units) has the second lowest ranking in apartment units (4,361 units) among the top five.

Three of the top five prefab producers are affiliates of large, diversified industrial organizations; one is an affiliate of a large general construction company; and only Misawa is exclusive to the housing industry (table 4.2.4). Sekisui House and Sekisui Chemical, through their Sekisui Heim division, have a combined production accounting for 35.8 percent of all prefab detached and low-rise apartment starts. In turn, the major shareholder of Sekisui Chemical is Asahi Chemical Industry, with 16.2 percent of the shares of Sekisui Chemical. Asahi Chemical, through its Hebel House division, is the sixth largest prefab housing company with 4,883 detached starts and 3,083 low-rise apartment starts in 1983 for a combined total of 7,966 prefab starts.

The Sekisui group of companies was founded in 1947 and is comprised of four key companies: Sekisui Chemical Company, Sekisui House Limited, Sekisui Plastics Company, and Sekisui Jushi Company. The group accounts for some 209 domestic

Table 4.2.2

Prefab Production of Low-rise Apartments By Company - 1983

Rank	Units	% Share
1. Sekisui House	22,293	40.0
2. National House	10,672	19.2
3. Daiwa House	10,667	19.2
4. Misawa Homes	4,361	7.8
5. Sekisui Chemical	3,083	5.5
Top Five Producers	51,076	91.7
Total Produced	55,688	100.0

Source: Building Center of Japan, 1984.

Table 4.2.3

Total Production of the Top Five Prefab Companies - 1983

Rank	Detached Units	Low-Rise Apartment Units	Total Units	% Share
1. Sekisui House	18,143	22,293	40,436	27.5
2. Misawa Homes	26,289	4,361	30,650	20.9
3. Daiwa House	10,127	10,667	20,794	14.1
4. National House	9,772	10,672	20,444	13.9
5. Sekisui Chemical	9,154	3,083	12,237	8.3
Top Five Producers	73,485	51,076	124,561	84.7%
Total Detached and Low-Rise Apartments	91,303	55,688	146,911	100.0%

Source: Building Center of Japan, 1984.

Table 4.2.4

Comparison of the Top Five Prefab Housing Companies - 1983

Rank by Production	1. Sekisui House	2. Misawa Homes	3. Daiwa House	4. National House	5. Sekisui Chemical
Total Production (83)	40,436	30,650	20,794	20,444	12,237
Year Founded	1960	1962	1955	1963	1947
Factories Producing Housing	4	22	12	4	6
Total Employees	8,014	1,105	5,672	2,010	6,038
Total Assets (million yen)	597,497	138,208	289,198	69,346	290,937
Equity Ratio	26.7	20.0	34.0	25.2	18.0
Major Shareholder	Sekisui Chem. (20.3)	Misawa Co. (9.6)	--	Matsushita (58.6)	Asahi Chem. (16.2)
Ownership by Japanese Banks (%)	13.4	10.4	14.9	6.7	8.6
Foreign Ownership	12.8	11.3	15.8	6.0	10.3
Sales Breakdown (%)					
Building Materials		69	87	63	
Housing Const.	79			27	38
Other Const.		13			
Housing Lots				10	
Real Estate	21		13		
Other Activities		18			68
Sales - March 84 (million yen)	443,742 (Jan. 84)	126,216	285,689	97,924	324,018

Source: Japan Company Handbook, First Section Firms, First Hall 1984, The Oriental Economist.

companies, twenty-five overseas companies, and seventeen thousand employees, with an aggregate annual sales turnover amounting to 1,170 billion yen for fiscal 1983. The products of the group range from raw materials to end-use products, including basic chemicals, intermediate industrial materials, and household and consumer products. Sekisui House Limited was established as an independent company in 1960, and 20.3 percent of its shares are still owned by Sekisui Chemical. Sekisui Heim, the Housing Division of Sekisui Chemical, accounts for about one-third of total domestic sales.

Asahi Chemical Industry Company Limited, the sister company to Sekisui Chemical and its largest shareholder, is one of Japan's largest companies, ranking twenty-second in the Fortune ranking of twenty-five Japanese Manufacturing Companies (1983) and ranking 130 overall in Fortune's international list. Total assets in 1984 were 722,669 million yen; it employed some sixteen thousand persons and had sales in the order of 760,000 million yen. Building materials and housing accounted for approximately 17 percent of total sales.

National House Industrial, fourth ranked in production of prefab detached units and fourth overall with a 1983 production level of 20,444 units, is controlled by the Matsushita group with a 48.0 percent interest (1984). Matsushita is best known in North America under the name Panasonic and throughout Japan for its National product name. Matsushita is ranked second in size among all Japanese companies by Fortune magazine, after Toyota, and is the number one producer in Japan of home VCR/VTR systems, colour TV sets, and industrial robots. It ranks second in research and development expenditures among all Japanese companies, with research and development expenditures for 1983 in the order of 195,000 million yen, and the company ranks first in overseas production.

The affiliations and ownership patterns of three of the top five prefab companies, Sekisui House, Sekisui Chemical, and National, gives some sense of the economic and industrial strength upon which prefab companies are founded. All three companies are linked to parent companies that have an interest in building materials and household consumer goods, established records of growth in assets, investment in research and development, direct contact with Japanese consumers, and an international perspective for their products.

Daiwa House Industry Company Limited belongs to another genre, the large-scale general construction company. Daiwa has divisions in detached prefab housing, multifamily prefab housing, general contracting, prefab commercial buildings, and real-estate development. Housing activities account for over 65 percent of total sales, and the detached housing division accounts for almost 65 percent of the employees. While certainly not on a level with Asahi, Sekisui, or Matsushita, Daiwa has pursued diversification characteristic of these large construction companies and has broad interests but at a reduced scale, not unlike its larger competitors.

Misawa Homes is the maverick and seems to enjoy, if not flaunt, this reputation. The company parts with the traditions of its competitors in many ways, most notably in its use of structural wood products, its independence from a large parent company, and its exclusive use of the franchise sales system. The high profile that its President, Chiyoji Misawa, enjoys nationally and, more recently, internationally is also a distinguishing feature of the company. This is a firm with a distinctive recipe for success that sets it well apart from Sekisui House, with whom it is constantly vying for top spot in the prefab rankings. Misawa Homes has maintained its position for a number of years as the number one producer of prefab detached homes, and even Sekisui House is far behind in this particular category.

Of the five companies, three produce a metal-frame unit with a composite exterior wall panel (Sekisui House, Daiwa House, and National House), one produces a modular wood-panel system (Misawa Homes), and one produces a modular steel-box system (Sekisui Chemical). Misawa, as part of its House 55 program, has launched a modular steel-box system using lightweight autoclaved concrete similar to the material used by Asahi Chemical in its Hebel House.

Steel-frame systems account for 64.0 percent of all prefab detached units, and this share has been somewhat constant over the past five years (table 4.2.5). Wood-panel systems account for 30.4 percent and precast concrete has 5.6 percent of the market. Whereas Sekisui House dominates the field in steel-frame construction (31.1 percent versus 17.2 percent for its closest competitor, Daiwa), Misawa has virtually no competition in wood-panel construction (90.1 percent of the market), with Kobori Juken a very distant second at 5.8 percent (table 4.2.6).

4.3 The Technical Appraisal System

All prefabricated housing systems in Japan are subject to rigorous government standards and must be certified through a technical appraisal program that has no counterpart in North America. This appraisal program, in fact, applies to all new materials and construction methods, not just industrialized systems, and was instituted by the Ministry of Construction in 1965 as a means of administering the Building Standards Law (1950), a nationwide building code.

The technical appraisal system, since its inception, has been administered by the Building Center of Japan (BCJ), and its specific application to prefabricated housing systems was initiated in 1973 with The Industrialized Housing Performance Approval System. This legislation gave the Ministry of

Table 4.2.5

Prefab Production of Detached Units by Type of Construction (%)

	1979	1980	1981	1982	1983
Steel Frame	58,061	58,939	59,435	63,615	58,404
	(66.5)	(65.3)	(67.9)	(65.9)	(64.0)
Wood Panel	23,422	25,436	22,336	26,980	27,736
	(26.8)	(28.2)	(25.5)	(27.9)	(30.4)
Precast Concrete	5,808	6,355	5,801	6,004	5,163
	(6.7)	(6.5)	(6.6)	(6.2)	(5.6)
Total Detached	87,291	90,730	87,572	96,599	91,303
					(100.0)

Source: Building Center of Japan, 1984.

Table 4.2.6

Prefab Production of Detached Units by Unit Type and Company - 1983

STEEL FRAME & PANEL	Units	Percentage
1. Sekisui	18,143	31.1
2. Daiwa	10,025	17.2
3. National	9,692	16.6
4. Sekisui Heim	9,154	15.7
5. Asahi Chemical	4,883	8.4
6. Nessiki	1,431	2.5
Top 6	53,328	91.5
Overall	58,404	100.0
WOOD-PANEL SYSTEM		
1. Misawa	25,208	90.1
2. Kobori	1,604	5.8
3. Dai-Ei	444	1.6
Top 3	27,256	97.5
Overall	27,736	100.0
PRECAST CONCRETE SYSTEM		
1. Tessei	2,721	52.7
2. Dai-Jugen	592	11.5
3. Kokudo	539	10.4
Top 3	3,852	74.6
Overall	5,163	100.0

Source: Building Center of Japan, 1984.

Construction the authority to approve the performance of various types of industrialized housing systems, and since 1973 the BCJ has been assigned this responsibility on behalf of MOC (table 4.3.1).

The Building Center of Japan was established in 1965, and although it was to be jointly funded by industry and government it proceeded without government appropriation and has since received its funding exclusively from industry. The BCJ was established as a public service corporation to administer MOC's activities under the Building Standards Law, and its duties as the "technical appraiser" for MOC forms the basis for all its other activities, including research and development, information services, and the promotion of dialogue between government, private industry, and the academic sector.

The technical appraisal service applies to any new material or technology a manufacturer or builder wishes to introduce to the market. Before MOC can authorize its use or application, BCJ issues an appraisal with respect to such factors as safety, conformance to regulations, and strength and durability of materials.

The appraisal service is also performed at the suggestion of government offices other than the MOC, and results may be used by the relevant administrative offices to confirm whether or not construction plans conform to relevant laws and regulations. For this purpose, the BCJ has eighteen permanent technical evaluation committees comprised of experts, including university professors and industry representatives, and covering such areas as high-rise buildings, structures, foundations, fire-protection performance, fire-resistance performance, emergency alarm systems, septic tanks, elevators, game facilities, sound insulation, computer programming silos, material durability, and industrialized housing.

Table 4.3.1

Prefab Housing Systems by Type Approved by MOC, 1980

Classification	Structure	Units sold	Number of companies approved by the Minister of Construction
Detached house	Wooden type	27,736	4
	Steel type	58,404	13
	Concrete type	5,163	11
	Subtotal	91,303	28
Multi-family housing low rise, 2-3 storeys	Wooden type	3,634	(4)
	Steel type	26,827	(13)
	Concrete type	5,481	(11)
	Subtotal	35,942	(28)
middle and high-rise	PC	19,229	
	HPC	4,982	4
	Other construction method	1,555	
	Subtotal	25,766	4
Total		153,011	32

Source: Building Center of Japan, 1984.

This technical appraisal system is supplemented by two other government programs that affect the quality and performance of industrialized housing systems and components. The Acknowledgement System of Factories with Good Quality Control for Prefabricated Houses and Other Articles was started in 1972 by MITI, and seventy-three factories had been approved through 1983 for their production methods and quality control. In 1974, MOC implemented The Excellent Housing Parts Approval System pertaining to housing components, including kitchen systems, bathroom fixtures, windows, etc.

4.4 Marketing the Product

Marketing must attempt to maintain that crucial balance between optimum production capacity and customer demand if a company is to be successful and prosper, particularly in view of the magnitude of plant capacity represented by some of the prefab housing companies. As a result, marketing is every bit as sophisticated, if not more so, than the automated production lines, CADCAM systems, and robotic assemblies seen in Japanese factories. To view prefab housing production facilities without understanding the equal investment in marketing and sales can be misleading and can distort the role of industrialization in the Japanese housing industry.

Unlike large North American home builders who are still regionally based, the Japanese prefab home builders operate as national companies, with the ability to offer products throughout the country. On the other hand, they are patently aware of regional differences in consumer preferences and, while co-ordinating marketing at the national level, will ensure that products are sensitive to these regional differences. However, this task is tempered somewhat by the fact that almost 90 percent of all prefab sales are within the metropolitan areas, and it is these markets that basically dictate current product lines and consumer trends. For example,

the trend to "Westernization" in Japanese housing is a reflection of a sophisticated urban market characterized by purchasers who are aware of Western-style housing either through travel or the mass media.

Investment in factories and equipment in the production end may well be matched at the marketing end by investment in show homes, advertising, and sales staff. Using 1980 figures as a basis of comparison, Misawa Homes that year sold thirteen thousand detached units through its franchise dealers, involving some seventeen hundred salespeople for a ratio of 7.6 units per salesperson. This sales staff operated from 163 branch offices and used 223 show homes (some of which were branch offices) for a ratio of 58.3 units per show home. Sekisui House had sales of 18,500 detached units in the same year, using direct sales with 2,250 salespeople for a sales ratio of 8.2 units per salesperson. This sales staff represented 38 percent of total employees and used 250 branch offices and 273 show homes for a ratio of 67.8 units per show home. Sekisui Chemical, the smallest of the top five producers, had sales of 7,600 units the same year, using a direct franchise system with 650 salespeople for a sales ratio of 11.7 units per salesperson. Sekisui Chemical had forty-two branch offices and 175 show homes for a ratio of 43.4 sales per show home.

While it is difficult to draw actual sales comparisons or measure sales effectiveness between prefab housing companies since sales methods differ considerably, surprisingly their sales ratios are somewhat comparable. As a general rule, sales staff operate at a level of approximately ten sales per year and show homes generate in the order to forty-five to sixty sales per year. But such comparisons do not do justice to the intense competition among the top five producers and the staunch defenses of the advantages of each respective sales system.

The sales system differs according to the prefab company's background and capital, the district or region in which sales are occurring, structure and construction process of the supply house, and the overall philosophy of the company. Sekisui House and Misawa Homes are exclusively committed to two very different systems, while the others use a combination or modifications of these systems.

Sekisui House operates all facets of its enterprise with its own employees and attributes to this direct system a high level of quality control since production and delivery are always in the hands of employees. Misawa, on the other hand, franchises every aspect of its operation to independent operators, from its factories through its sales offices and, now, its interior design or "Homing" service. It claims to maintain an equal penchant for quality control through comprehensive training programs for its franchise operators. National House also relies on a franchising system similar to Misawa, but only for its dealerships and not its production facilities, and it maintains control over this network through a 50 percent interest in each dealership and extensive training programs for its sales staff. Both Daiwa and Sekisui Chemical operate with a combination of direct sales and wholly-owned dealerships, the difference with dealerships being that site contractors are employees of the dealership and not the parent firm. Ninety percent of Daiwa sales are through these wholly-owned dealerships.

Sales offices, whether dealerships or direct sales, vary in size depending upon location and the organization of the company's delivery functions. In the case of Sekisui Chemical, the smallest of the top five producers, the smallest dealership sells thirty units per year and the largest dealer five hundred units per year, with a staff of eighty including sales staff, architects and engineers, construction managers and supervisors, service personnel, and administrative staff.

Sekisui Chemical, in spite of its relatively small size, currently maintains 230 display homes.

Misawa Homes, the largest producer of detached homes, adapted its franchise system from the automobile industry and sought people from the automobile industry to set up the system in its early years. Today, Misawa has 160 franchised dealers in Japan, each of whom is responsible for sales, construction, and servicing. These dealers can tailor their product to local markets and are responsible for local and regional advertising at their own cost and for bearing the costs of providing and maintaining show homes. A dealership operates on the same basis as the auto dealer, purchasing products at a discounted price from the factory, usually 15 percent below list price, and extracting overhead costs and profits from the sales margin. Misawa dealers average between twenty and thirty employees, with the largest in the system, Tokyo Misawa Homes, having two hundred employees. Misawa maintains three hundred show homes throughout Japan.

Promotion and sales use various techniques, the most productive of which, by general consensus among all five producers, is the show home park. These show home parks represent a formidable investment in buildings, land rent, advertising, and labour costs, but their value as retail outlets for the housing industry is well proven. Referrals from previous customers are another important source of new customers in addition to more selective means such as local media and newspaper advertising, inserts in monthly or quarterly housing catalogues, direct and mail solicitation of apartment and rental dwellers, and presentations at large companies or to social gatherings. The sheer quantity and extent of advertising is most noticeable throughout the metropolitan areas, including subways and buses, billboards, television commercials, and transit and railway stations.

There are some seventy show home parks in the Tokyo metropolitan area, spread out along the major transit routes, and it is inevitable that one will find at least one show park within walking distance of a transit or rail station. These displays may range in size from three to upwards of forty homes. The Sendai Show Home Park, on a portion of land vacated by the Osaka World Fair, has forty-eight show homes and is currently the largest in Japan; Tokyo Housing Fair in Shinjuku, with nineteen display units, is perhaps one of the most popular, certainly with tourists.

Unlike their North American counterpart, these show home displays are downtown in commercial cores, are as near as possible to the proverbial 100 percent sales corner, are readily accessible by transit or train, and are not permanent installations. The show home park, depending on location, will combine traditional home builders, prefab companies, and, now, 2 x 4 builders, and within the inner core areas, such as at Shinjuku, these parks will be dominated by the big names in the industry.

The more prominent show home displays are operated by major communications companies who will rent a vacant site and operate the entire display, including an advertising and promotions package. Both the Sendai and Shinjuku displays are operated by Asahi Broadcasting Company (ABC), the largest of such operators. The show homes themselves have an effective life span of between two to three years and pay a monthly fee to the operator. In the case of Sendai, this fee is 1.5 million yen per month including the land, management fee and advertising for the display park. Newspaper and periodical advertising costs are extremely high in Japan, but in turn this printed material can reach very large market areas compared to North America. A single-page advertisement in a monthly housing catalogue, requiring a standard format, will cost one million yen and, therefore, it is not unusual

for a company to spend upwards of 3 percent of its income on advertising.

Marketing is not seen just as sales and promotion but is an integral part of the entire delivery process, of which the salesperson is the key actor. To understand the significance of his or her role, it is necessary to examine a typical sales scenario. It is likely that the salesperson has met the potential customer, a housewife and her mother, in a display home on a weekday. Weekend visits to show homes are a social occasion and generally preclude the serious buyer. Therefore, the best salesperson occupies the show home on weekdays and makes house calls on weekends. It is not unusual for a salesperson to have compiled a list of potential customers three years in advance of purchase, and these families will keep him or her busy on weekends.

After the initial contact, the salesperson may visit the customer at their residence to gain an overview of the situation, covering such aspects as the site, particularly if it is a rebuild situation, ideas and expectations for the house, and financial arrangements. This may be followed by a visit to a particular show home with the customer or another visit to the site with technical personnel, or the architect, to assess site conditions and constraints. The salesperson will explain the company product, begin to draw out the customer's requirements, and prepare rough sketches of the layout. The customer will be encouraged, on the basis of a sales brochure, to pursue a particular product line, and the depiction of various options and arrangements within the brochure assists them to "design" their custom home.

Through interaction between the customer and the salesperson, a set of working drawings and a schedule of costs will be prepared and presented and eventually, upon acceptance, these will constitute the sales agreement between the parties. In

the course of preparing these documents, the salesperson will have used the technical expertise available within the dealership, including the architect and interior designer who will have prepared the final drawings and costs, likely using a CADCAM system. Upon execution of the agreement, the salesperson will then move on to co-ordinate and eventually handle all service and after-sales activities.

The salesperson is the customer's contact with the company through the entire process and, as such, he or she is a valued, experienced, and well-trained individual, and perhaps the company's greatest asset. His or her worth to the company will be reflected in the proportion of salary versus commission, good performance being rewarded with a higher ratio of salary to commission.

4.5 Trends in Research and Development

The fact that between 1976 and 1980 the top five prefab housing companies spent $76 million U.S. of their own funds on research and development gives some indication of the importance of this activity within the prefab industry and certainly sets this industry apart from anything comparable in the United States. Today, Sekisui Chemical, the smallest of the top five, spends $2.5 million U.S. annually on research and development, and Misawa budgeted 1.5 percent of sales or $7.5 million U.S. in 1984. But these are levels of expenditures quite common among Japanese industries and are not allocated for purposes of national prestige. The basic mechanism for the allocation of research and development funds in Japanese industry has been the market, and the guiding incentive has been private profitability.

A major characteristic of research and development has been the comparatively low level of spending on high-risk, long-term research in favour of spending on modifying and

improving existing products. Product improvement, often using imported technology as a base, has traditionally been given priority because the returns are regarded as more certain. The claim might be made that development far outweighs research and that what might be deemed research and development in Japanese industry would not qualify for such a title in North America. Allocations for low-risk and short-term projects also reflect the preference of Japanese researchers for the esteem gained within the company from immediate technical success over accreditation or recognition among peers.

These characteristics may explain, in part, why private industry seemingly pays for a larger share of the research and development effort in Japan than in other industrialized countries. In 1982, Japan spent 2.78 percent of its national income on research and development, of which 23.6 percent was publicly funded. In the same year, it is estimated that the U.S. spent 2.86 percent of its national income on research and development, but 46.7 percent was publicly funded.

Today's surveys may still be indicative of trends through the 1960s and 1970s, where economic growth was the requisite objective. As with so many forecasts in Japan, the recent past may not portend well for predicting the near future. Where so many of Japan's technological resources in the past have been directed toward economic revival, now there is increasing evidence that recent attempts are directed toward using technology to achieve social goals--particularly those concerning the environment. What remains uncertain is how great a sacrifice will be made in the use of research and development for purely economic growth toward achieving quality-of-life goals.

The move toward quality is evident within the current posture of the major prefab companies, who now stress the importance of the total living environment and not just new materials or the performance requirements of the housing envelope. The emphasis on new materials and assemblies is giving way to a new emphasis on residential amenities such as bathrooms, kitchens, appliances, and electronic systems. Many of these products could be viewed as luxuries for and not necessities of the home.

Perhaps House 55, launched in 1975, symbolized the ultimate fulfillment of a research program, ranging from basic building materials through composite wall systems, fabrication, and erection that characterized the research and development programs of the prefab housing companies in the 1970s. Each of the top five producers still operates a research institute, complete with an environmental test chamber capable of submitting an entire house to simulated earthquakes and to virtually any type of weather condition from snow accumulation to rain, solar radiation, and typhoons. The results of these efforts not only produced new products such as Misawa's precast autoclaved lightweight concrete panels (PALC), Sekisui Chemical's composite cement/wood-chip particle board panel (Synsilite), and Sekisui House's aluminum-faced exterior sandwich panel but led to vast improvements in quality control and material performance while lowering production costs.

There now is a perceived shift away from research into housing as shelter and toward ideas that reinforce the notion of housing as a consumer commodity in an increasingly affluent and discriminating society. While technical research has by no means subsided, it is being complemented by researchers in various housing-related fields such as psychology, human engineering, geriatrics, industrial design, and acoustical engineering.

In 1982, the Industrial Structure Council of MITI, attended by both government and industry, discussed a long-term vision of the Japanese housing industry. This discussion established a new context for the housing "problem"; housing should be viewed in the context of education, regional culture, and family and community life--the emphasis should be placed upon improving Japan's own "residential culture". As part of the strategy to create a better cultural environment, the notion of adaptability and flexibility was introduced, where integrated or compatible components could be grouped for each unit of living space and distinctions could be drawn between the life expectancy of different groupings ranging from the structural frame, with perhaps a 100-year life span, down to kitchen appliances with a five-year effective life.

New developments are still appearing on the assembly line to reduce inventory, increase choice of product, reduce costs, and, no doubt, increase profitability. Computer-aided design and drafting systems are now commonly used from point of sale through product design and production. Energy efficiency is still a major preoccupation, and the prefab companies are realizing the full potential of the renovation and after-sales market for new products, materials, and components.

Research and development is still a healthy activity as measured by investment along the major prefab housing companies, and, combined with the initiatives of government through MOC and MITI, it is not likely to subside in the near future. What one can expect is a basic shift in research and development activity away from technical improvements on the supply side, most notably product improvement, toward greater research efforts on the demand side, specifically into consumer preferences and behaviour and emerging lifestyles. The research and development thrust is toward bolstering and expanding the demand for products for which the manufacturing capacity is already in place and for which a greater market share is expected by the producers.

4.6 2 x 4 Construction--A New Competitor

A discussion on the Japanese housing industry today must inevitably touch upon the most recent competitor in the field--North American 2 x 4 wood-frame construction. There appears to be an increasing interest among both prefab housing companies and traditional home builders in the potential competitiveness of this new building system, particularly as two of the largest names in Japanese industry, Mitsubishi and Mitsui, are associated exclusively with 2 x 4 construction. There are some potent reasons for the recent success of 2 x 4 construction in Japan, and it may be argued that North American 2 x 4 construction offers all the advantages of the prefab house without the concomitant capital investment in plant and machinery. If nothing else, the introduction of 2 x 4 construction in Japan provides a basis of comparison upon which to judge the effectiveness of both traditional and prefab housing in providing North American housing styles to Japanese consumers.

Given the traditional Japanese house with its emphasis on wood, it would seem that 2 x 4 construction could be a logical alternative to traditional Japanese home-building methods. Yet 2 x 4 construction has struggled since its introduction in 1972 and it is only now emerging as a serious competitor. Wood 2 x 4 construction was not able to keep pace with the emergence of the prefab housing companies for a variety of reasons, and it will likely continue to run a very distant third to traditional and prefab building methods with less than a 2 percent market share.

If it is the intention of government to stabilize and maintain a market share for the traditional home builder and the intention of the prefab housing companies to increase their share from 15 percent to say 30 percent, then what is the future of 2 x 4 construction? Growth in 2 x 4 construction,

if it occurs, will likely be at the expense of, first, the traditional home builder and, second, the prefab housing market.

The incentive to consider 2 x 4 construction dates back to the early 1970s, when Canada and the United States passed legislation forbidding the export of timber logs. However, the legislation in the U.S. was never enacted and subsequently applied only to logs from publicly-owned forests. Canada did enact this legislation. If enacted by both countries, this legislation would have virtually eliminated a prime source of much of the timber stock from which the sizes required for traditional Japanese post-and-beam construction are milled. This reduction in supply, combined with the relative ease in purchasing milled lumber from North America in nominal dimensions during periods of peak housing demand, led to consideration of actual 2 x 4 construction methods using nominal lumber sizes.

From a cost and technical performance standpoint, 2 x 4 construction outperformed traditional Japanese wood construction methods, particularly in view of the change from the historic open-style Japanese house to the western style closed house. But the Ministry of Construction did not certify the system for a variety of unknown reasons, and 2 x 4 houses required special permits until August, 1979. There was certainly little, if any, government encouragement up to 1979. In 1983, there were 18,300 detached 2 x 4 housing starts for a 1.7 percent market share and a 10 to 15 percent growth rate over the past several years.

In 1976, the Japan 2 x 4 Home Building Association was founded. Their intent was to promote 2 x 4 construction among traditional house builders and improve their competitive edge over the prefab housing companies in view of a declining housing market. Government viewed 2 x 4 construction as one

means of modernizing and strengthening the practices of the small builder, but quite the opposite occurred. Large builders now control the overwhelming share of 2 x 4 starts and, where the traditional Japanese home builders operate at a level of twelve to thirteen units per year (as compared to seventeen to eighteen units per year in the United States), the average Japanese 2 x 4 builder is at a figure of ninety units per year. The 2 x 4 association estimates that the break-even point today for a 2 x 4 builder is fifty units per year compared with four to five units per year for the traditional builder. What has caused this discrepancy?

First, and perhaps foremost, consumers have not adjusted to this new product. While intellectually they can understand the advantages, they hesitate when it comes to making the investment in something unfamiliar and they inevitably return to the traditional home builder. For example, they are not convinced that a house can have structural strength without columns and beams. Large companies can overcome this resistance with name recognition and past performance in the consumer market, but the small builder suffers, even with an improved product at competitive prices. Second, suppliers and materials are not readily available at local supply houses, and the traditional trades are unfamiliar with the nominal lumber sizes, specifications, and different building materials. Even the nails for 2 x 4 framing are very different. The larger firms, through advanced purchasing and direct contact with overseas suppliers, again can better cope with the situation. Both Mitsui and Mitsubishi are trading houses and can control the entire purchasing and supply network, right back to timber sources in North America.

Third, the financing of home construction in Japan precludes access to a builder's loan, and, instead, the builder relies on credit from suppliers or advances from the purchaser during construction. The Japan House Corporation, for example, only

releases mortgage funds upon completion of the house and there is no provision for interim financing. If 2 x 4 lumber is hard to find locally, credit on such purchases is virtually impossible to secure or, at best, is limited to one house at any time. Major financial barriers continue to exist that no small builder can cope with alone.

Finally, 2 x 4 framing skills are neither readily found nor easily acquired among small builders. There is marked resistance to forfeiting the traditional carpentry skills that have been handed down generation to generation for a new set of skills, less sophisticated and still unproven. Large companies can organize training sessions, attract and train new work crews, and have access to overseas technical expertise when required.

Like the prefab housing companies, 2 x 4 construction is going through a consolidation, with the likely outcome being the domination of a relatively few large companies. In the tradition of the big prefab housing companies, the big names in 2 x 4 construction will also be part of a larger industrial conglomerate, that is, Mitsubishi and Mutsui, accompanied by several well-capitalized home builders who will successfully make the switch from traditional 2 x 4 construction. The 2 x 4 industry is not yet as settled as the prefab industry, but it has the advantage of having had the prefab companies lead the way in competing with the traditional home builder. These lessons are by no means falling on deaf ears, and the similarities in consumerism between Mitsui and Mitsubishi and the top five prefab housing companies is not coincidental.

Mitsui Home Company Limited was established in 1974 through joint investments by Mitsui Real Estate Development Company Limited, Mitsui and Company Limited, and the Mitsui Norin Company, as a home builder specializing exclusively in 2 x 4 construction. The company operates as a fully integrated

housing company in the same vein as the major prefab companies, with the emphasis on custom-designed housing sold through both direct sales and franchised dealers. Sales of detached houses in 1983 were 1,645 units, and this was exceeded by condominium sales of 2,838 units in the same year.

Mitsui Homes has eleven hundred employees involved in various facets of its main company and its subsidiary organizations. Mitsui operates with twelve branch sales offices that average sales in the order of 120 to 140 units per year and that have one hundred show homes, some of which operate as sales offices. In addition to direct sales through the branches, there are four franchised dealers with 50 percent ownership by Mitsui, similar to National House. Three subsidiary organizations operate in the areas of material supply, interior consulting, and after-sales service.

Mitsui Home Components Company Limited is a joint investment of Mitsui Home Company Limited (70 percent), Mitsui Real Estate Development Company Limited (20 percent), and Mitsui Lumber Company Limited (10 percent). This subsidiary is responsible for housing component processing, lumber regrading, precutting, truss making and assembly, and delivery of house packages. It is also engaged in the stocking and delivery of windows, doors, and all other accessories and appliances and acts as a materials distribution centre. Both plants are conveniently located on dock-side piers at Chiba City on the outskirts of Tokyo.

Mitsui Homes Interiors now has some 120 branches, and as well as complementing new sales this subsidiary is following the same route as Misawa's "Homing" service and is actively pursuing the home renovation market. Mitsui Homes Service was established as a subsidiary for after-sales service, to operate the ten-year home warranty program offered by Mitsui.

Figure 4.6.1

Mitsui Show Home, 1984

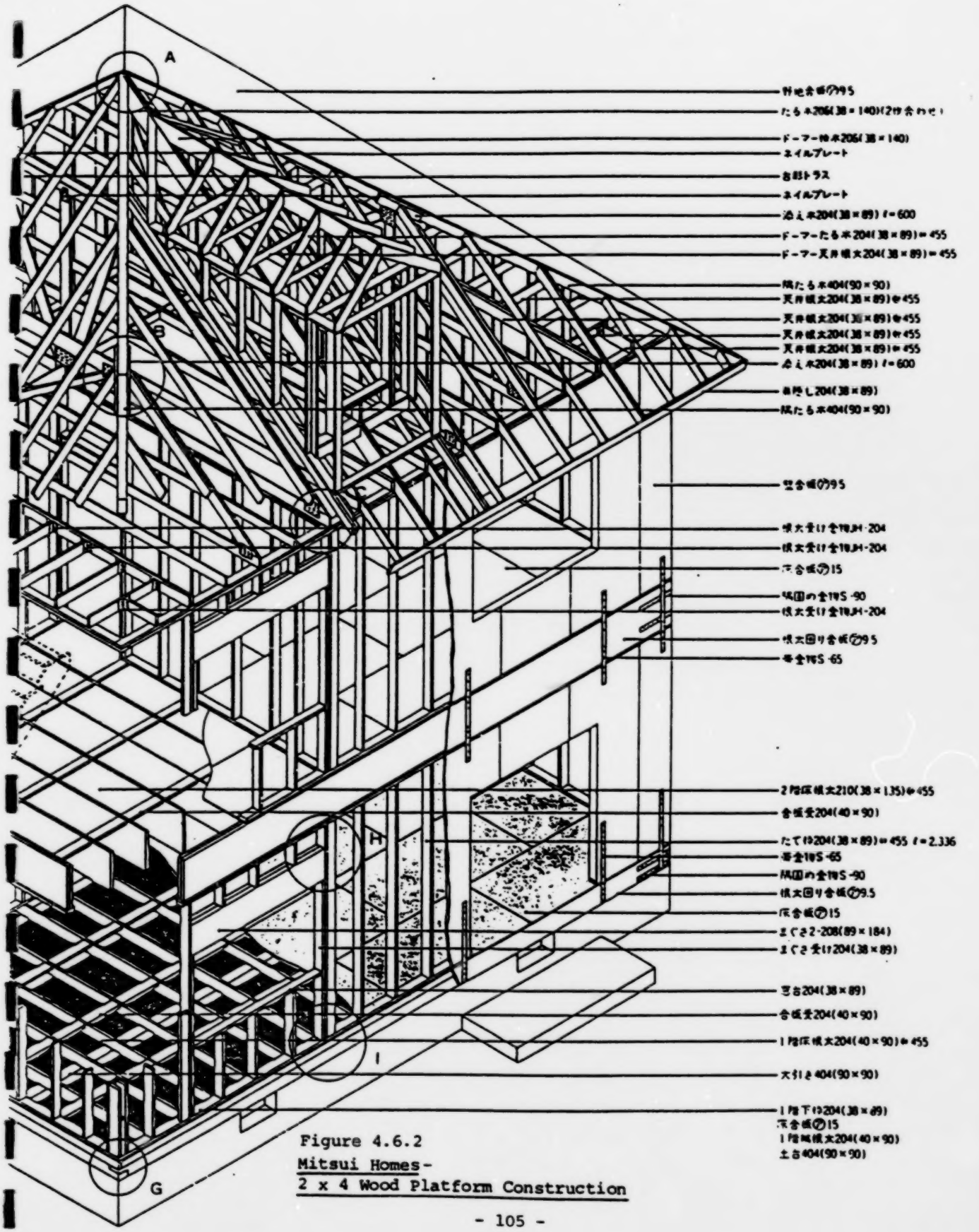


Figure 4.6.2
Mitsui Homes-
2 x 4 Wood Platform Construction

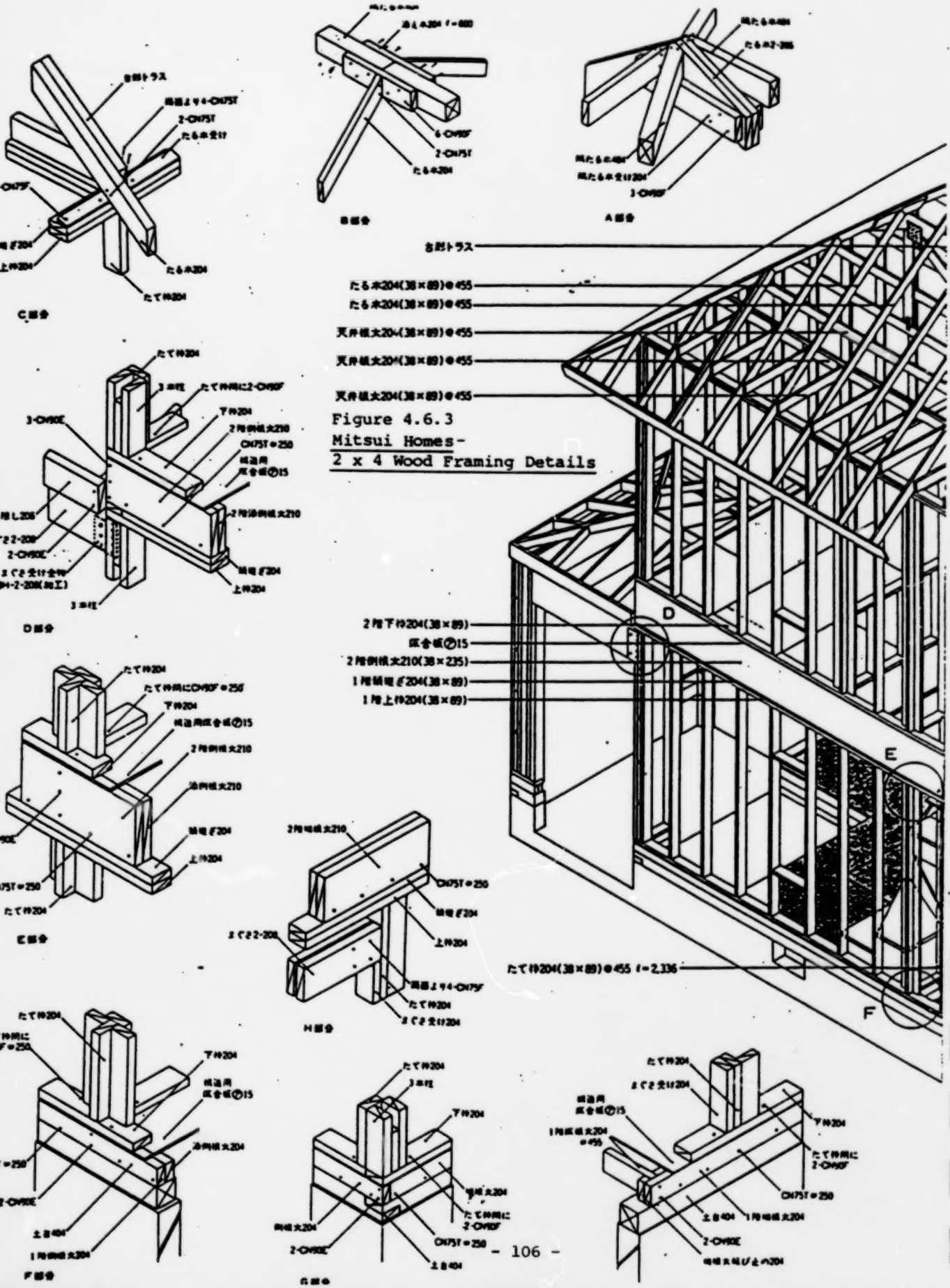


Figure 4.6.3
Mitsui Homes-
2 x 4 Wood Framing Details

All on-site construction is subcontracted, but Mitsui is every bit as advanced in controlling the entire process as the prefab companies and offers a totally integrated approach to its customers in direct competition with the prefab housing companies.

Mitsubishi Estate Housing Components Company Limited was established in October, 1983, and commenced operations in April, 1984, as supplier of 2 x 4 housing components for Mitsubishi Estate. Mitsubishi Estate Home Company is the newest entry into 2 x 4 housing construction and commenced operations in October, 1983, also as a wholly-owned subsidiary of Mitsubishi Estate. The parent company, Mitsubishi Estate Company Limited is Japan's largest office leasing company, with interests in residential land and construction and architectural services.

Both Mitsui and Mitsubishi have access to new subdivisions in outlying areas through their respective parent organizations, and, although they do undertake some housing construction on new land as subcontractors to their parent companies, the major proportion of their activity is within the Tokyo metropolitan area. They are in direct competition with prefab housing companies for the custom-designed home in the rebuild market.

These two companies essentially have followed in the footsteps of the major prefab housing companies but with one major difference--they have avoided the investment in manufacturing facilities and substituted the distribution centre for the factory. They are relying on an existing building technology and a secure prospect for the continued importation of lumber products. While their annual production levels are well below that of the top five prefab companies, there is every evidence of consumer acceptance of the product and strong growth is predicted. In recognition of this potential competition, some

of the prefab companies have begun to experiment with 2 x 4 construction in limited situations.

It is not an unlikely prospect that the competition among traditional builders, prefab companies, and, now, 2 x 4 companies could lead to government intervention in the form of industrial rationalization. Such rationalization is practised widely by MITI and implies the creation of a framework for all enterprises in a particular industry in which each can co-operate to achieve a particular market share in a cartel-like arrangement of mutual assistance. For example, government has already placed members of prefab housing companies as representatives on government-sponsored committees to improve upon and promote traditional wooden houses. This interaction among seemingly competitive sectors of an industry is but one way of rationalizing the involvement of all three sources of housing production over the long run.

4.7 Conditions for Success

A number of factors have contributed to the relative longevity of the prefab housing industry in Japan and to its more recent successes. Certainly, the high population density concentrated in and around the major metropolitan areas satisfies one of industry's key criteria, access to large markets. But there are other factors, not as readily discernible, that might lead one to conclude that if the long search to establish a prefabricated housing industry were to finally succeed Japan would be the logical place.

Not only is Japan's population situated in a very limited area but this concentration is located within relatively moderate climates with the exception of Hokkaido to the north. A manufacturing plant can survive with shipping distances in the range of 200 to 250 kilometres and may reach production levels of one thousand houses per month based on its own catchment

area. The rigid requirements for earthquake design and fireproof construction make steel an appropriate framing material, and the relatively moderate climate alleviates the problems associated with the use of metal in colder climates. It must also be remembered that Japan's highly efficient steel production has kept steel prices far below those of North America. Houses generally do not require heavy insulation and, therefore, various lightweight composite wall panels can be used in conjunction with steel framing. The performance requirements for the building enclosure are not severe, with the exception of moisture control within the outer wall, and where severe humidity is encountered, such as at Hokkaido, the achievements of the prefab house have been less than notable. Prefab housing is a product whose success has been exclusive to high-density urban areas, particularly the Tokyo, Negoya, and Osaka regions, and its impact on rural housing and in Hokkaido has been negligible to date.

With four of the five top prefab producers using a steel frame and requiring four to seven tons of steel per house, much of the automated equipment and factory assembly processes are directed at forming, shaping, welding, assembling, and storing steel parts. This requires large factories, enormous economies of scale, and massive capital investment in manufacturing facilities. It also requires a wage structure in which factory workers are either paid the same or lower hourly rates than on-site workers such that there are no additional costs in transferring manpower from the field to the factory.

These large factories can only be built through access to capital markets, favourable financial terms, long-term stability in demand, and by companies with a proven record in manufacturing and in the consumer goods business. It is not a coincidence that the prefab housing industry in Japan is dominated by very large companies with diverse interests and

experience in the production of construction materials and chemicals. Access to capital markets by these firms is not based solely on their performance in housing or construction-related activities, and Sekisui Chemical, for example, which had total assets of $1,497 billion in 1984, was involved in the production of raw materials to end-use products, including basic chemicals, intermediate industrial materials, and a range of household and consumer products.

The financial structure of these companies gives a sense of their borrowing capacity, and, in addition to a very low equity to debt ratio by North American standards, banks are active business partners and in it for the long term. Commercial loan rates have been traditionally well below North American counterparts, and the role of the Japan Development Bank in providing long-term, low-interest loans to the prefab housing industry in the 1970s for new plants and equipment cannot be underestimated. The banking and financial system in Japan is an integral part of the success of these large corporations, and the subject is deserving of its own study. Suffice to say, government claims that it has offered its corporations a higher return on capital, has taxed them more lightly while nevertheless obtaining more revenue, and has promoted high rates of savings, investment, and growth in the corporate sector. It seems that the whole financial structure of these prefab housing companies would be foreign, if not alien, to both the government and the housing industry in North America.

The influence of government policy must also be recognized and, in particular, the effect of the five-year housing programs that provide stability as well as insight and direction for the industry and some measure of insulation from the vagaries of political decision-making. These programs give evidence of a government willing to subsidize the supply as well as the demand side of the equation, and government can

also accept a portion of the credit for nursing the prefab housing industry through its formative years. But the reasons for success in the early years are quite different than those for recent successes, and it is a tribute to the industry that it has adapted so well to recent consumer trends within the marketplace.

Success today can be attributed to a number of factors. First, the prefab housing industry has concentrated in those markets where it does best, the metropolitan areas. Ninety percent of all sales of prefab houses are in urban areas, and, therefore, the industry is now capitalizing upon its existing capacity and avoiding costly ventures into new areas. It is estimated that the industry could double production with existing manufacturing facilities. Second, the industry is taking advantage of the market for scattered site-replacement housing within the urban areas. This is the market where prefab housing can be most cost competitive with traditional building methods, offer better quality control, shorten on-site construction times (important when the family is displaced after demolishing the existing family house), and alleviate the need to organize a sequence of building trades at a remote site. Third, the industry has overcome the stigma of mass production by emphasizing the "free style" plan where each house can be tailored to individual preferences. Industrialization has now become synonymous with customization, and prefabrication now offers more flexibility than that found in the traditional wood-frame house. Finally, the industry has concentrated on housing and, after initial flirtations, seems to have successfully cast aside the inevitable appeal of land development. Land and lot inventories have been the demise of so many home builders even in Japan. Although several of the top five prefab companies can point to recent substantial losses in the land business, they have all redirected their efforts to housing production and to re-establishing housing as a profitable venture with gross margins reportedly approaching 25 percent.

5.0 THE MAJOR PREFAB COMPANIES

5.1 The Top Five Producers

SEKISUI HOUSE

Sekisui House Limited was established in 1960 by the Sekisui Chemical Company Limited, and the parent company is still the largest single shareholder with a 20.3 percent interest. Other major shareholders include:

Sanwa Bank	4.6%
Daiwa Bank	4.0%
Dai-ichi Mutual Life Insurance	3.4%
Sumitomo Bank	3.2%
Nippon Life Insurance	2.0%
Lloyds Bank International	1.6%
Foreign Ownership	15.5%

The firm has maintained its ranking as first among Japan's prefab house builders for a number of years, and performance is equally strong in the detached and low-rise apartment market. Business activities of the company include the construction, sale, purchase, and lease of buildings; development, sale, purchase, and administration of residential land; design, execution, contracting, and supervision of construction projects; brokerage and sales agent for the purchase and sale of real estate; cultivation, sale, and purchase of plant material and landscape design and construction of gardens; nonlife insurance; and the administration of welfare facilities of the company and its affiliates (some fifty-eight domestic affiliates).

The company employed 8,750 persons (as of April, 1984), including 440 authorized first-class architects, 1,135 second-class architects, and 1,560 licensed real-estate dealers. Approximately 38 percent of the company's work force is involved in sales, reflecting Sekisui's exclusive reliance on a direct sales for all its products. The company now has over six hundred sales offices throughout Japan, including some 275 show homes. Products are manufactured at four factories located in Ibaragi, Shizuoka, Shiga, and Yamaquchi Prefectures. The Shizuoka factory is the location of the company's housing research and development facilities.

Although Sekisui House promotes a steel-frame and modular panel industrialized system, its products include all types of residential buildings and commercial and institutional structures in steel-frame, ferro-concrete, wooden, and even 2 x 4 construction. One factory still produces products for the traditional house, although in very limited quantity. Housing products account for 79 percent of sales, with 21 percent in real estate although the company has recently reduced its involvement in land development through reduction of the land inventory.

Only 20 percent of the company's house sales now include a land component, and only 2 percent of sales are speculative. Eighty percent of housing sales involve only the house, and in almost every case these units are custom-designed to fit a particular site and a set of individual preferences and requirements.

Sekisui House prides itself in its ability to control the entire process from sales through production, erection, and after-sales servicing by direct employees at every stage. It does not use franchising or dealerships and depends exclusively on direct sales. This approach is taken to their production lines where, for example, they will manufacture

Figure 5.1.1

Sekisui House Show Home, 1984

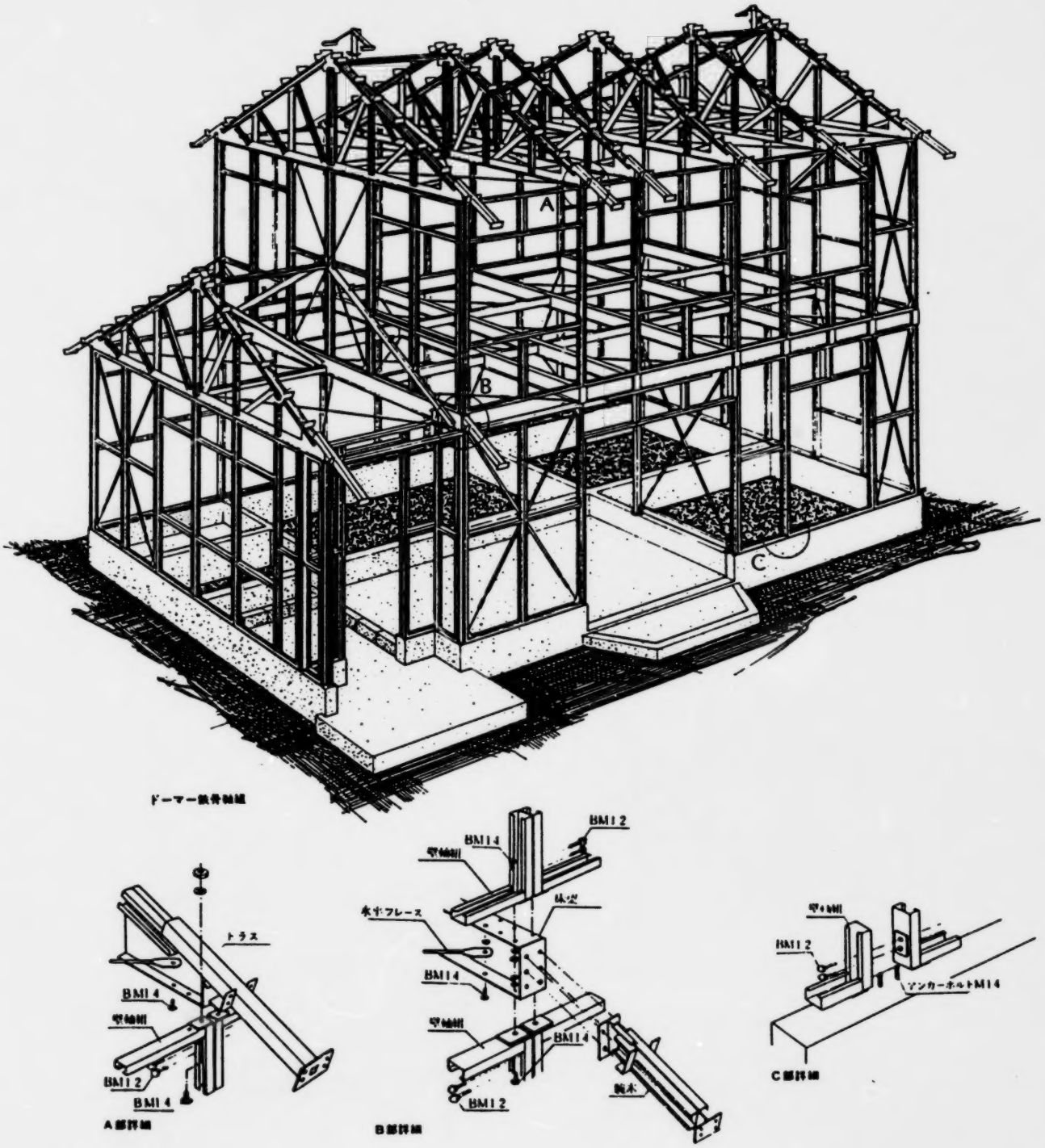


Figure 5.1.2
Sekisui House -
Light-gauge Steel Framing System

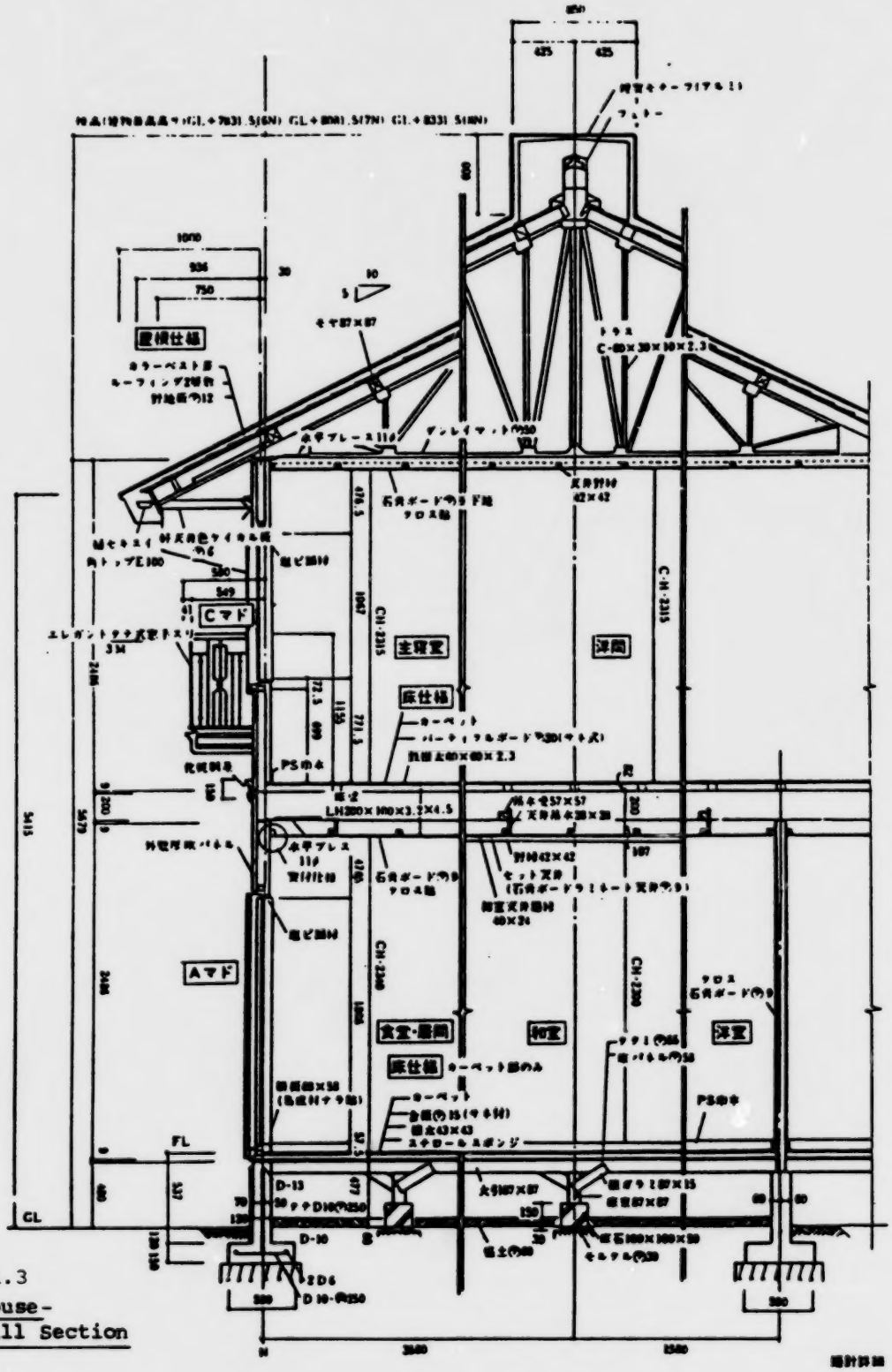


Figure 5.1.3
Sekisui House-
Typical Wall Section

many of their own housing components from raw materials whether of wood, steel, or synthetic origin. This direct control is a key feature of their claim to consistent high quality, reliable performance, and flexibility of product.

A Sekisui house is constructed on a light-gauge steel frame, including wall members, floor members, and roof trusses, set upon a poured-in-place concrete footing and clad with modular composite exterior panels. The factory production system can be broken into four major processes.

1. Steel Frame Process

Light-gauge steel sections and structural components are shaped from roll and flat stock, cut and assembled, and subsequently treated and painted through an electrodeposition process to prevent corrosion and rust. After baking, steel components, accessories, and frames are stored in automated vertical warehouses. The entire steel-frame process is highly automated, using similar procedures to those widely used in automobile and electric appliance manufacturing.

2. Panel Process

Exterior composite wall panels, of seven-layer construction, are composed of an aluminum plate exterior skin cemented to a hardboard backing; steel framing members; foam insulation, either polystyrene or, preferably, a phenol-based foam with greater fire resistance; an intermediate air space; and gypsum board interior paneling. The exterior aluminum surface is painted with special acrylic resin in preparation for a uniform coating to be applied on-site after erection. The interior surface is finished on-site with vinyl roll material. As with the steel-frame members, these panels are also stored in automated vertical warehouses until their recall for shipment.

3. Woodwork Process

All lumber is purchased kiln-dried to strict moisture content specifications. The lumber shop performs mitre processing of door frames, framing members for wooden houses, roof purlins, exterior jumbo modular wood panels for apartment houses, and truss and wall panels for platform wood construction. In addition, inner fixtures such as sill, head jamb, window frame, and other trim features are manufactured by a computer-control led system that automatically positions and dimensions wood components, performs all cuts at the desired angles, drills nail holes, and processes all connecting joints.

4. Warehousing Process

Sekisui House looks upon its factories as veritable department stores of housing components, and the company has devised an automatic vertical warehouse system capable of storing and controlling all component parts for quick recall in response to customer requests. The entire warehouse is computer controlled, and a single operator can perform all operations from receiving and shipping of members to storage and inventory control of those items. In the case of the Shiga factory, the warehouse measures 30 m (100 ft.) in width, 70 m (230 ft.) in depth and 24 m (80 ft.) in height and is equipped with a total storage area of 8000 m^2 (86,000 $ft.^2$). The storage capacity is equivalent to five hundred complete housing units.

Based on a unit size of 100 m^2, the Kanto factory averages a production level of five hundred units per month, with a maximum capacity of eight hundred units per month. This level is maintained with one work shift of four hundred employees working six days per week with two Saturdays off per month. The standard work week is forty-five hours, and

overtime may run from thirty to forty hours per month. The storage system is capable of handling one month of production, although inventory is usually at the two hundred unit level or ten to fifteen days of production. The loading yard has the capacity for shipping at the rate of sixty-six units per day using three shifts, and the average shipping distance is in the order of 300 km. Exterior components require two to three ten-ton flatbed trucks and interior components require one or two four-ton trucks.

Sekisui's average house size is now 120 m^2, with an estimated retail price of $52,000 U.S. (13 million yen) including delivery and on-site assembly and finishing, but excluding furniture, utility hook-ups, and landscaping. The entire process from initiation of work in the factory, following confirmation of the sale, to completion on-site takes approximately fifty to sixty days.

MISAWA HOMES

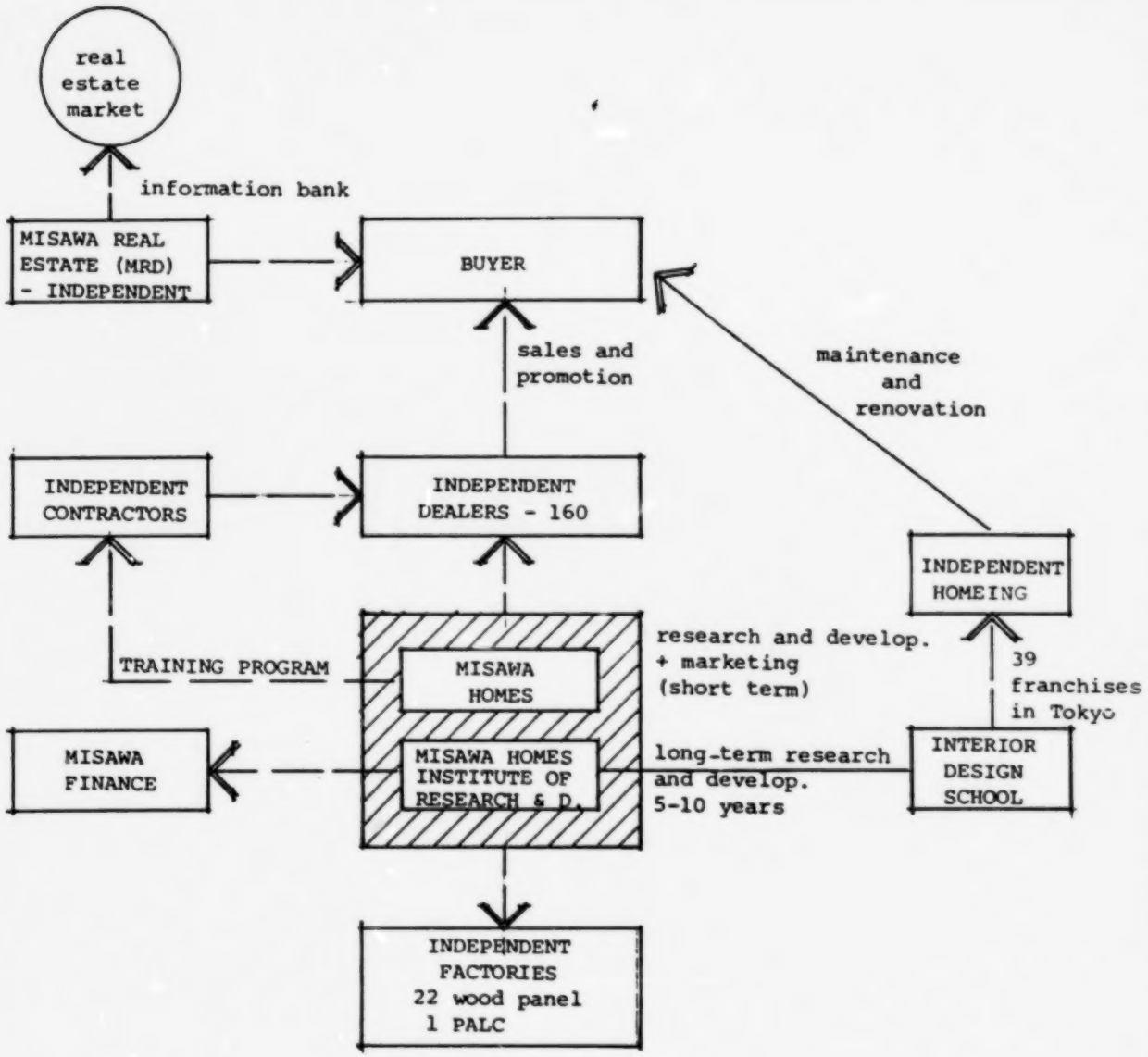
Misawa Homes was established in 1967 but can trace its history back to a family business, Misawa Lumber Company, established at the turn of the century in Matsumoto. Origins in the lumber business gave rise to Misawa's domination of the prefab wood housing market today. Founder and current President, Chiyoji Misawa, controls 9.6 percent of the shares. Other major stockholders include:

Tokai Bank	5.8%
Nippon Life Insurance	5.5%
Chiyoda Mutual Life Insurance	3.0%
Dai-Ichi Kangyo Bank	2.5%
Jiro Misawa	2.3%
Dai-Ichi Mutual Life Insurance	2.3%
Toyo Minka	2.2%
Sanwa Bank	2.1%
Foreign Ownership	11.3%

Misawa Homes ranks second among the top five prefab housing companies and has an established reputation as Japan's leading manufacturer of prefab detached housing. However, the company has not matched this record in apartment construction and its position in the apartment field with a steel-frame and wood-panel unit and, now, with their PALC system is yet to be established. Misawa has virtually no competition in the wood-panel system and has secured 90 percent of this market with its nearest competitor, Kobori Juken, having only 6 percent.

Misawa might be termed a maverick among the major prefab housing companies in that its major product grew out of and still relies upon the lumber industry. On the other hand, it is recognized as an innovator in almost every aspect of its approach to the housing industry. From its inception, the company has emphasized research and development as a foundation to its growth and prosperity and has sought to control, but not necessarily own, all facets of the housing supply system from raw materials through after-sales service and renovation work. Misawa employs only eleven hundred persons. This figure gives an indication of its reliance on a franchising system that is now becoming more popular among others in the industry.

The Misawa Total System is predicated on an orgnizational structure that relies on Misawa Homes as the co-ordinating body for a host of independent companies that operate as franchises under the Misawa name. Misawa Homes is responsible for overall administration and personnel training activities; its affiliate, Misawa Homes Institute of Research and Development, handles product development, research, and information gathering; independent manufacturing plants produce the components; and a dealer-contractor network promotes sales and delivers the product to the consumer.



1983 30,650 Units
1,105 Employees

Figure 5.1.4

MISAWA HOMES -

ORGANIZATIONAL STRUCTURE

Source: Misawa Homes (adapted).

Misawa's major product has been the wood-panel system, but through its House 55 it has launched the PALC (precast autoclaved lightweight concrete) system on a light-gauge steel unit frame. Housing products are manufactured in twenty-three factories, twenty-two of which produce stressed skin wood panels. The new factory at Negoya was built exclusively for the PALC system and opened in 1982.

Misawa's stressed skin panel system uses a range of panel types and sizes for exterior walls, floors, partitions, and roofing, and panels are classified by structure, sheathing, connection, insulation, and size and configuration. The Matsumoto Panel Plant is the largest and the oldest of Misawa's production centres and serves the Tokyo and Nogano regions. The plant employs 120 persons and specializes in large-size pre-stressed panels and historically has concentrated on production of various "fixed" housing plans versus "free-style" plans.

The factory has undergone three major changes since it first started operations in 1970, and these changes are perhaps indicative of trends within the prefab industry. First was the introduction of a large-panel system (up to 3 x 4 metres) in lieu of the standard small panels; second was the conversion to the exclusive production of large panels to reduce on-site labour; and now the recent conversion program to produce a range of panel sizes, in sequence and in small runs, to increase "free-style" options and reduce inventories.

The Matsumoto plant previously operated with 120 panel sizes and types that combined to produce three basic housing models, with fifty available options for each model. With the recent conversion to a production line that adjusts to varying panel sizes, these three house types now come with up to three hundred options, requiring upward of four hundred panel sizes

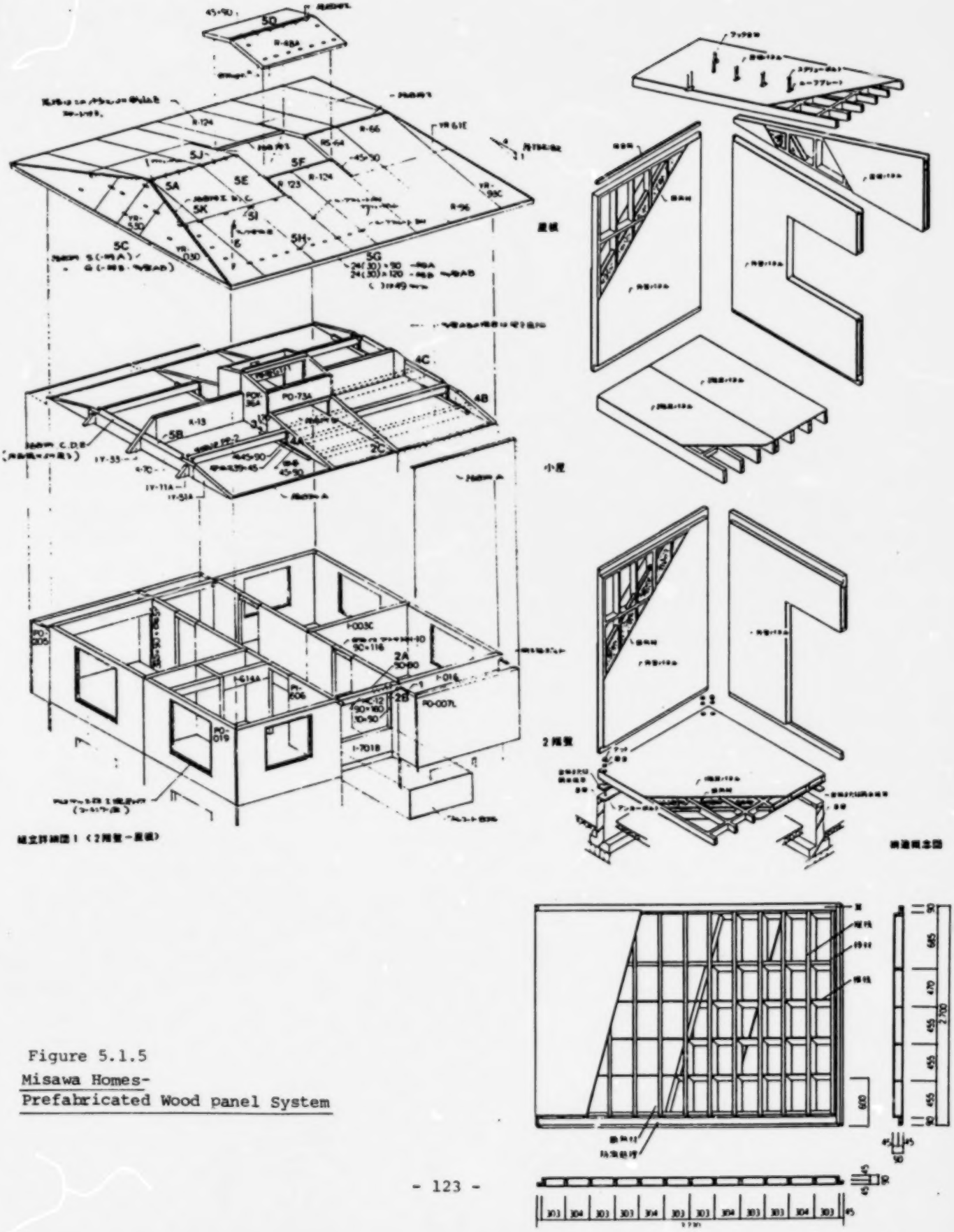


Figure 5.1.5
Misawa Homes-
Prefabricated Wood panel System

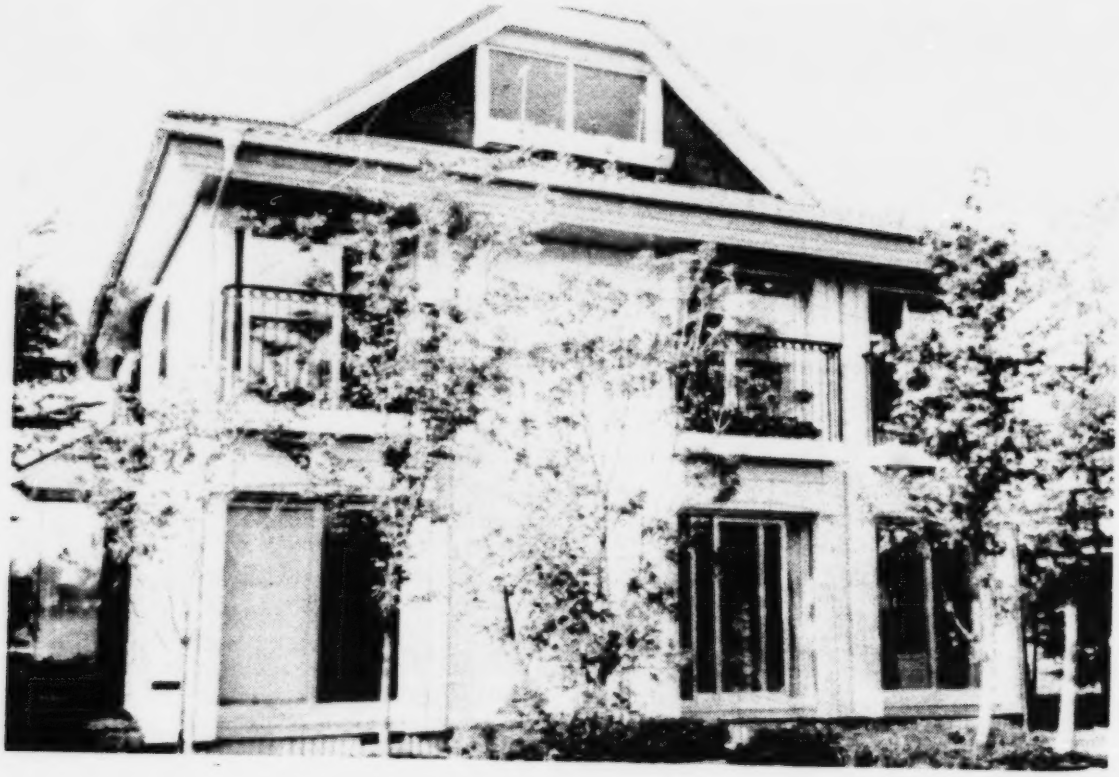


Figure 5.1.6

Misawa Homes -
House 55 Using PALC

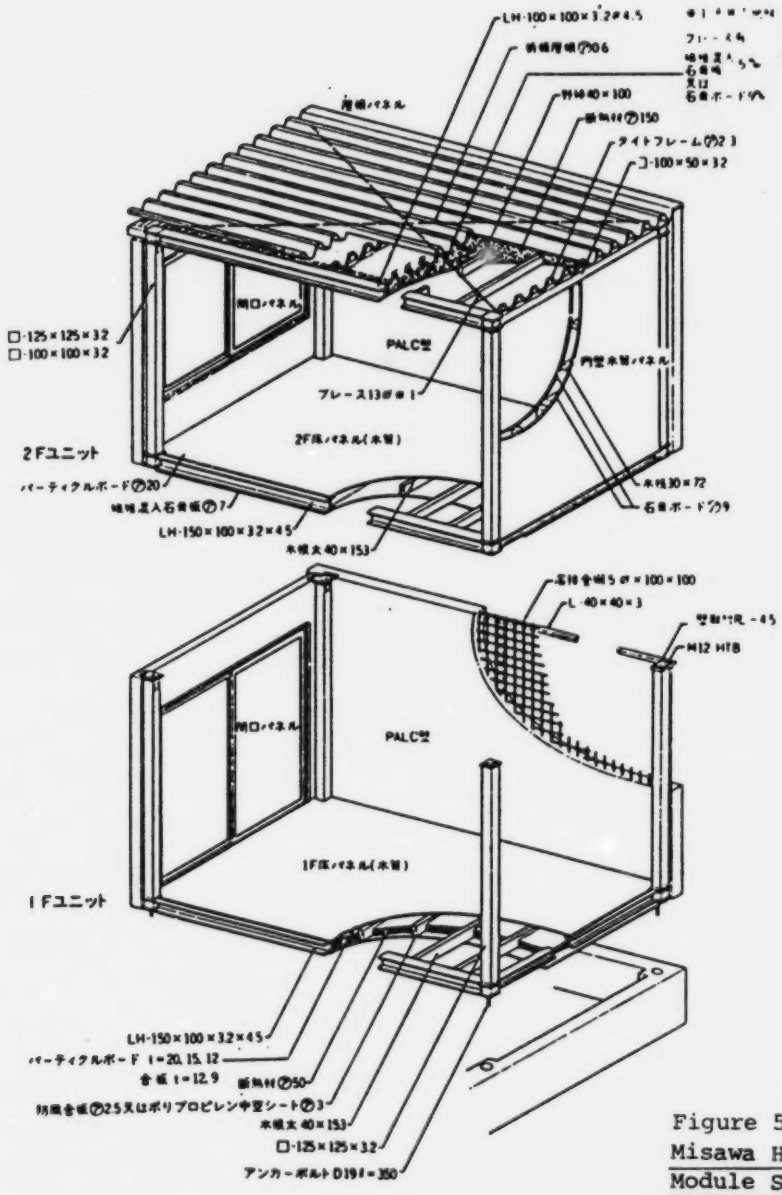
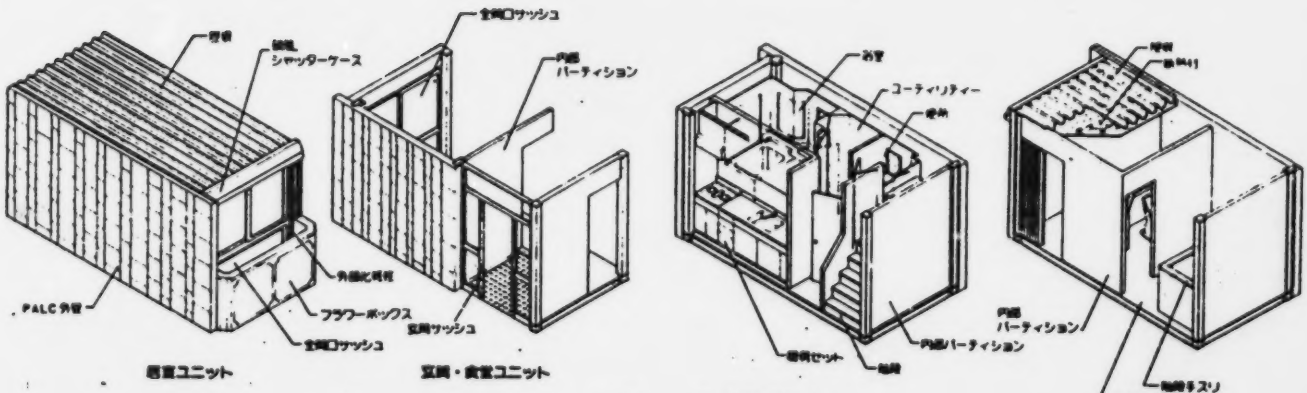


Figure 5.1.7
Misawa Homes
Module System Utilizing
PALC Panels



per model. Panel sizes have increased from 120 to four hundred and two panel types are offered--normal and fireproof. The sequential production of differing panel sizes on a demand basis also reduces the need for on-site inventory, which had previously been sustained at a level of approximately eight thousand panels and consumed about 60 percent of the total factory area. Further work now is being done to increase the ratio of factory finishing of components.

The production capacity at the Matsumoto plant is nine thousand panels per month, equivalent to 250 completed units. Current production objectives for the plant are:

1. to increase production efficiency and reduce the time between placement of orders and delivery date;

2. to increase the variety of panel sizes in short production runs;

3. to increase the level of finishing in the factory versus on-site; and

4. to reduce all inventory at the plant.

In June, 1984, Misawa launched the Misawa Production System (MPS) with the objective of reducing inventory by 50 percent by year end. This implied changes throughout the production process and a changeover to a demand system. Lead times are reduced for ordering new materials, and the inventory of materials at any given time is minimized. With an anticipated freeing up of former storage areas for both raw material and finished components, the plant is looking to new products and finishing processes to use excess space and manpower.

This move into related products is exemplified by Misawa's finishing plant opened in May, 1983, at Matsumoto, the location of Misawa's first wood-panel factory. The plant specializes in the production of finger-joint stock from scrap materials to be used in the manufacture of staircases, furniture, trim features, and other finished wood products. Rather than produce the finished articles, the plant is concentrating on developing new exterior and interior finishes as well as finger-joint stock and supplying these to manufacturing subcontractors.

Misawa's House 55 represents a radical departure from the wood-based components on which the company's reputation is founded. Misawa introduced a new patented "ceramic" product as an alternate to wood for its House 55, and its production of PALC was the culmination of thirteen years of research and costs of some $35 million U.S. (8 billion yen)[10], of which $6.6 million U.S. (1.5 billion yen) was subsidized by the Japanese government.

The manufacturing process begins with a slurry of water, silica, cement, and additives into which minute air bubbles are blown. The bubble-filled slurry, which is poured into moulds, sets after thirty minutes and then is autoclaved (cured at a high temperature and pressure) at 180°C and 10 atmospheres. The result is a porous, lightweight material suitable for a range of applications and with properties that resemble concrete.

Misawa has adopted the unit capsule for House 55, in which PALC wall panels are hung on a rigid steel box frame. The standard module is 4.5 x 2.75 x 2.3 metres complete with doors, windows, and interior finishings and services. A

---

10. Estimated on 1980 exchange rate of $U.S. = 226.74 yen.

standard house requires ten modules which are transported to the site, two per truck, and erected on a poured-in-place concrete footing.

Chiyoji Misawa's enthusiasm and energy seems to be a very large part of the success of Misawa Homes, and his entrepreneurial style has no doubt contributed to the success of the company over the years. He firmly believes that there is still much room for cost reduction in housing and sees three areas for improvement: 1) technical innovations through new materials and new types of technologies--a further 30 percent cost reduction; 2) rationalization of distribution--a further 10 percent cost reduction; and 3) mass production--a further 10 percent cost reduction.

Historically, the housing industry has examined technical innovations and rationalization of distribution, and Misawa in particular, through its research institute, has examined category one. However, Misawa is now changing its focus to categories two and three, although technical innovation will always remain a preoccupation of the company.

Research is a main activity within Misawa Homes, and current programs of the Misawa Institute of Research and Development include material handling and delivery methods, material development, and promotion of research and development activities with outside interests. The company currently has some 120 persons, including members of the institute and outside interests, involved in this research and budgets 1.5 percent of its sales revenue for research and development.

Reflecting this commitment to new ideas is Chiyoji Misawa's requirement that employees meet an annual quota for new ideas. He also professes to meet ten new people each day, and his search for information is compulsive, if not legendary, within the company. Misawa cites the U.S. Apollo Program as a key

source of personal inspiration and claims that this program has become a model for organizing and co-ordinating the actions of various disparate companies toward common objectives under the Misawa banner. From NASA's approach, Misawa learned that no single company could send a man to the moon but through a network of companies the challenge could be met. This resolve to apply and co-ordinate new technological systems pervades much of Misawa's activities and shapes the philosophy of the company today.

New long-term developments being pursued by Misawa represent a shift from technical innovation, as applied to the means of production, to a broader concern for the overall well-being of the user. This new research thrust falls into three broad categories, as described by Misawa:

1. Mechatronics

Mechatronics is the current Misawa "starplayer" and involves innovation in three areas referred to as the "three innovations"--factory automation, office automation, and home automation. Lately, a fourth innovation has been added: sales automation. In the case of factory automation, Misawa claims to have improved plant productivity by a factor of 7.5 over the past ten years and cites a reduction in labour time required to construct a house from 200,000 minutes for a typical Japanese post and beam down to 60,000 minutes per unit for the prefab pre-stressed wooden panel system. Today, he claims that the PALC system has further reduced this time to 10,000 minutes per unit.

In office automation the emphasis is placed upon a data bank in which data on successes and failures of the company can be compiled at a rate of one hundred cases per year. This data bank then becomes a reference source for engineers engaged in product development as well as a training resource for new

employees. In home automation, Misawa specifies five items--security, cleaning, washing, cooking, and sewing. Assuming that the house life is one hundred years, the household appliances will be replaced every ten years and the interiors every five years. It is the company's policy to market houses complete with electrical appliances which ensure the realization of these five items rather than relying on others to supply these items. Subsequent maintenance and after-sales service and renovation of this living environment also falls within Misawa's purview.

Sales automation is being pursued through the application of television in marketing activities. A sales attache case is equipped with tape recorder, transmitter, and receiver to allow the salesperson to describe the features of a Misawa home merely by selecting a TV channel. Also, through an on-line hookup between the customer's telephone set and Misawa's equipment, the customer is furnished with real-estate information and house-market information, including availability and prices of housing lots.

2. New Materials

Chiyoji Misawa believes that the 1990s will be the age of clay and inorganic compounds, also called "new ceramics", in the housing industry. These are materials that provide performance advantages over wood in terms of cost, heat-insulating qualities, freedom from corrosion, durability, and dimensional stability, but, most important, they are produced from materials readily available in Japan. In the case of House 55, it is claimed by Mr. Misawa that comparable traditional costs have been reduced to 1/40 in raw materials, 1/40 in transportation, and 1/20 in on-site construction labour, all by virtue of the technical innovations represented by PALC. Through future declines in the cost of silicone solar cells, Misawa sees the possibility of freeing the

homeowner from the need to procure electric power from a utility company and views the possibility of eventually freeing the home entirely from purchasing gas, water, and other services and utilities from outside sources.

3. Biotechnology

Misawa is already spending a considerable portion of its research budget on what it calls biotechnology or the relationship between the house and the well-being of its occupants. Areas of investigation range from hydroponics in the home to the effect of colour and building forms on the growth and development of children. The company has been researching some twenty medical relationships between the house and the occupants, including such topics as the effect of airtightness on asthmatics.

Misawa Homes is in an era of transition, moving from its historical roots as a wood-panel prefab company toward a much broader concept of providing not just shelter but a home environment predicated upon a very high amenity level. The firm is now adapting its philosophy, as represented by its franchising system, to include many more home products and sees its future as the NASA of the Japanese housing industry.

DAIWA HOUSE INDUSTRY COMPANY LIMITED

Daiwa House was established in 1955 and has maintained a strong presence in prefab housing from its inception. It is still guided by its founders, the Ishishashi brothers, and Nobuo Ishibashi, Chairman of the Board, retains a 2.1 percent interest. Other major stockholders include:

Tokai Bank	4.9%
Sumitomo Bank	4.9%
Dai-ichi Mutual Life Insurance	4.5%
Nippon Steel	4.0%
Mitsui Trust and Banking	3.0%
Nippon Life Insurance	2.2%
Foreign Ownership	15.8%

Daiwa has consistently ranked third among the top five prefab companies. It ranks second behind Sekisui House in production of steel-frame prefabricated detached units, third behind Sekisui House and Misawa in overall production of detached units, and is a close third to National in production of prefab apartment units. In 1983, sales in apartment units exceeded sales of detached units for Daiwa, and apartment sales are viewed as a strong growth area with the introduction of three-storey prefab apartment units.

Daiwa launched its first product in 1955, a pipe-frame house that was sold to Japan National Railways and subsequently to various government agencies that had cause to house employees at branch locations throughout Japan. This was followed shortly after by the production of the "Mizet" or "Midget" House offered to the public in 1959. The Mizet was conceived in response to the growing shortage of space for children in post-war housing and was intended to provide a study space that could be installed in the rear of the existing house. Its design had to meet three criteria: be inexpensive, not exceed three hours for construction time, and be lightweight but durable. The actual product measured only 2.72 m x 3.63 m and was constructed of lightweight steel with hardboard wall panelling.

The initial pipe-frame house for the JNR and the subsequent Mizet House forged two directions for Daiwa's growth: the pipe-frame house led to general contracting activities involving steel fabrication and erection, and the Mizet House was the start of prefab housing operations.

Daiwa employs some 5,670 persons (as of March, 1984) of which approximately 65 percent are involved in prefab housing operations. This large employment force reflects the company's greater reliance on direct sales versus dealerships. Almost 90 percent of all house sales are through company salespersons, with the remainder through a limited franchised operation.

The company has recently reorganized along four major product lines: single-family detached prefab housing, multi-family prefab housing, general contracting, and commercial prefab buildings. Various smaller divisions cover such activities as the home centre business, urban development, resort hotel and recreational facilities, and research and development. Daiwa has also ventured into the foreign market as well as being an active participant in housing and urban development schemes in South America, Africa, the Middle East, Southeast Asia, and China. It currently operates four subsidiary companies in the United States, principally involving 2 x 4 housing construction in California and Texas.

Daiwa House has twelve manufacturing plants, nine of which produce prefab housing components. The Ryugasaki plant, near Tokyo, has the highest production level of the nine plants with approximately 300 units per month.

Daiwa's lightweight steel framing system is essentially a post-and-beam system (Rhamen system) with modular wood panels for walls and flooring. Exterior wall panels combine a light-gauge steel frame with a cement-asbestos exterior skin,

Figure 5.1.8

Daiwa House Show Home, 1984

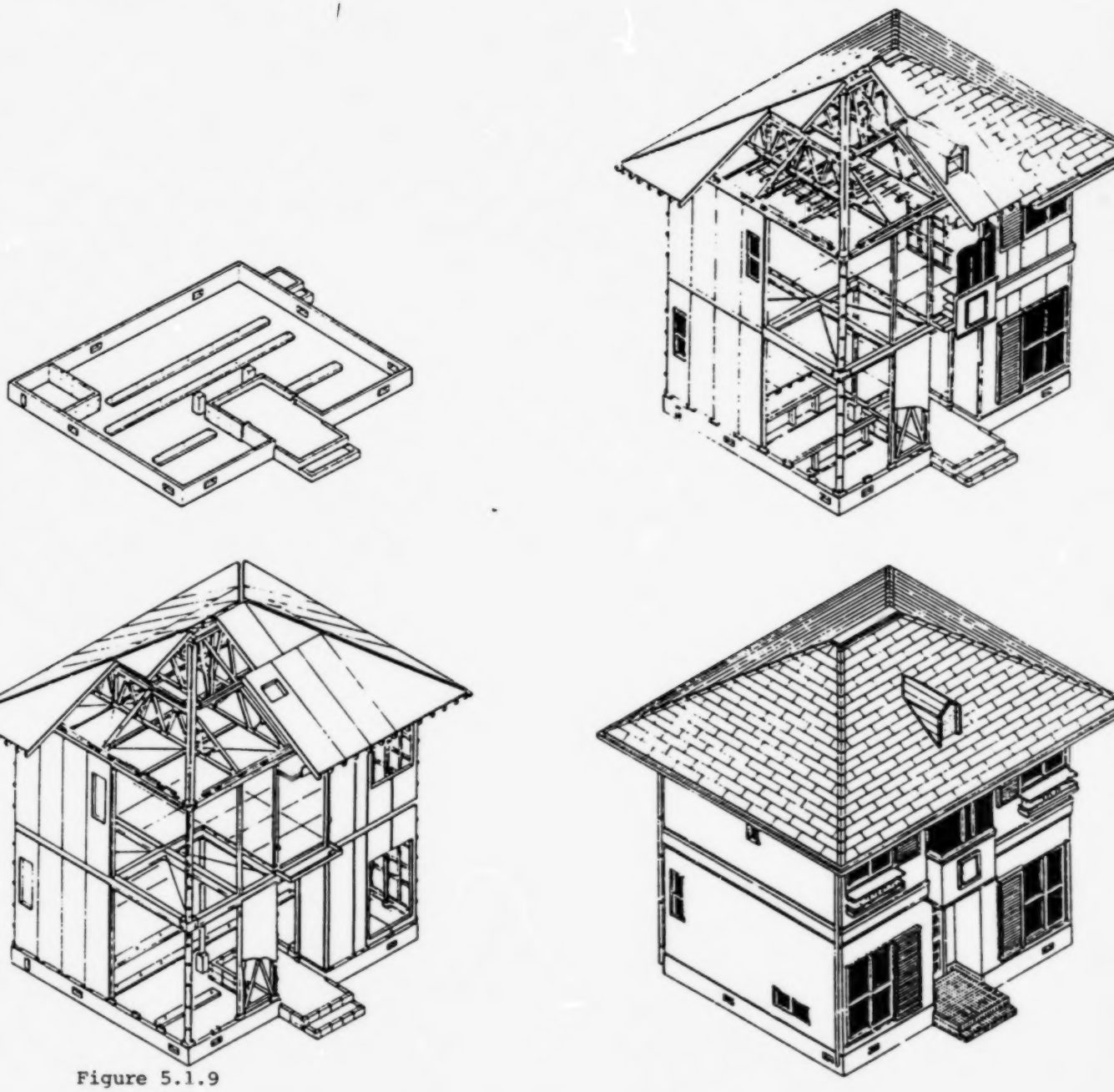


Figure 5.1.9
Daiwa House-
Steel Framing System

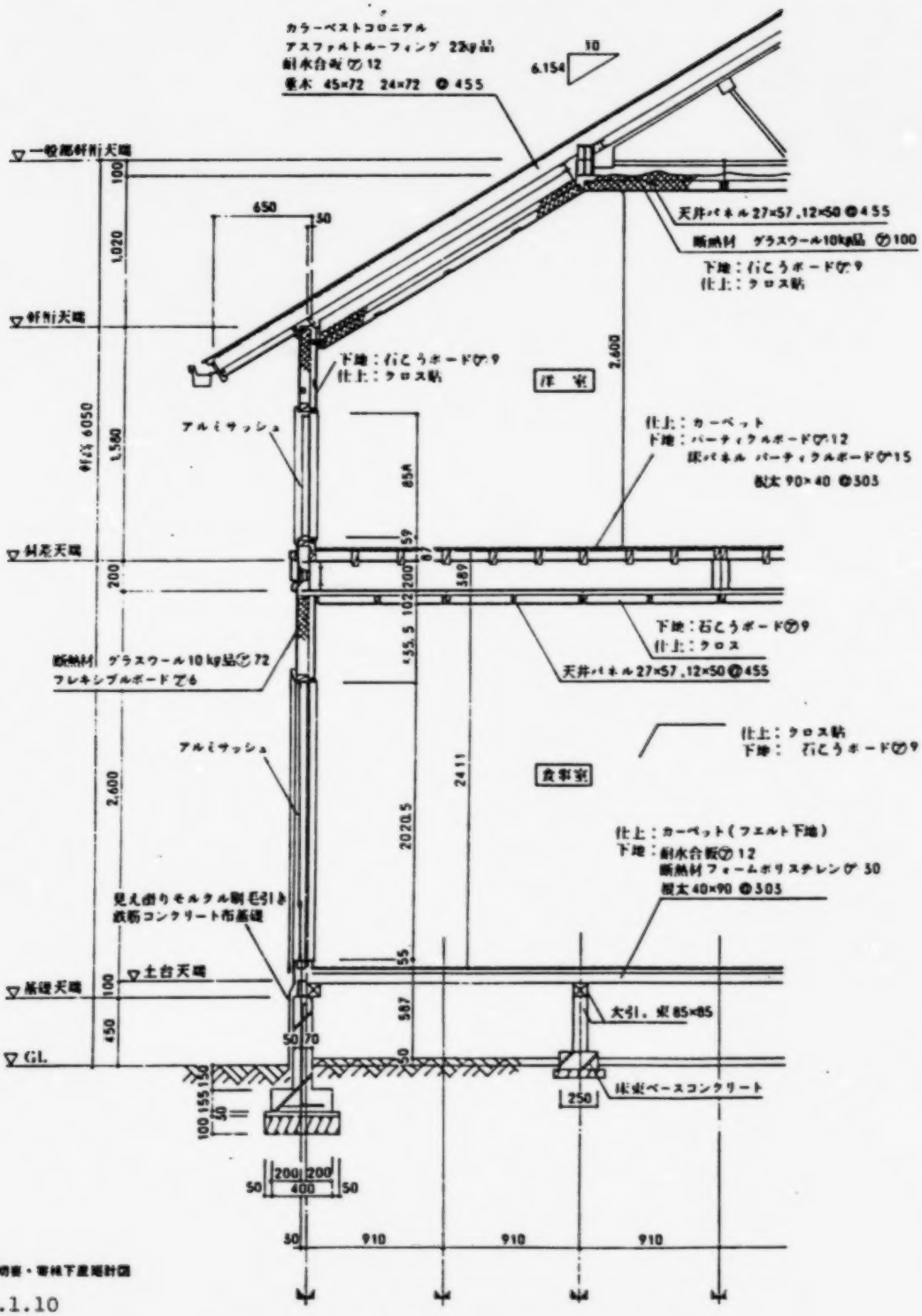


Figure 5.1.10
Daiwa House -
Typical Wall Section

wood studs, batt insulation, and a reflective mylar vapour barrier. Exterior and interior finishing, windows and doors, and all electrical, mechanical, and plumbing are done on-site. Floors are constructed with a stressed skin wood panel spanning steel beams.

Daiwa operates with fifty-seven sales offices, each of which may encompass three separate field divisions (show homes), for a total of around 150 show homes throughout Japan. Approximately 30 percent of sales are "fixed" plans and 70 percent are "free-style" plans, although this ratio is now changing and "fixed" models have again gained in popularity over the past five years.

NATIONAL HOUSE INDUSTRIAL

National House Industrial Company Limited was established in 1963 through the investment of Matsushita Electric Company Limited and Matsushita Electric Works Limited, each of which still retain a 29.3 percent ownership. Other major shareholders include:

Sumitomo	2.6%
Kyowa Bank	1.8%
Hench and Co.	1.6%
Nippon Life Insurance	1.5%
Konosuke Matsushita	1.4%
Foreign Ownership	6.0%

National House has consistently ranked fourth among the top five prefab companies. It ranks third behind Sekisui House and Daiwa House in production of steel-frame prefab detached units, fourth overall in production of detached units, and second behind Sekisui House in prefab apartments. In 1983, sales in apartments exceeded sales of detached units and this

is seen as an important market area with the recent popularity of three-storey, low-rise units. The company is also placing increasing emphasis on House 55, now in its second year of sales.

National House views its role in the housing industry as an extension of its extensive world-wide involvement in the supply of household appliances, home entertainment systems, and a variety of products relating to the home and the needs of daily life. Its products are best known in North America under the brand name Panasonic. The company now seeks to integrate appliances and its other home products with its production of building materials to create a model of good living. However, these products are not directed exclusively to National's own house-building operations and National products are used extensively by other prefab builders, including Sekisui House and Daiwa House.

National House employs some 2,150 persons (as of April, 1984) including seventy authorized first-class architects and 130 second-class architects. The small number of employees compared to Sekisui House or Daiwa House is a result of National's reliance on dealership for sales and its role as product supplier to these dealerships. Of the twenty-one hundred employees, approximately six hundred are factory workers, 350 are professional staff including architects and engineers, 150 are head-office staff, and the remaining one thousand are involved in sales throughout the various branch offices. Of these one thousand in sales, seven hundred are in branch sales offices and dealerships, and three hundred are involved in direct sales, the majority of which are to local public housing corporations. National operates show homes at 270 locations throughout Japan and has eighty branch offices and 240 dealerships.

Products are manufactured at three factories: Koto serving the Osaka/Kyoto region, Tsukuba serving the Tokyo region, and Kyushu serving the southern region. There is also a small distribution centre in Hokkaido. Although National offers a number of building types including the large-panel construction method using light-gauge steel reinforcing frames, the Rhamen construction method using light-gauge steel posts and beams, and 2 x 4 construction, it is the steel-frame system that is the mainstay of their detached prefab housing system. This places National in direct competition with Sekisui House and Daiwa House among the top five prefab companies.

Selection of the light-gauge steel-frame system was initially predicated on two objectives: first, reducing reliance on wood and wood products which, it was assumed, would be subject to increasing scarcity and increasing cost; and second, the ability to seek improvement in quality through mass production of steel components. The automated production systems now used by National have been some ten years in the making. However, with this increased production capacity through automation has come the necessity to secure high levels of constant demand for these products. Production levels of seven hundred units per month at the Koto plant, with a maximum capacity of one thousand units per month, represent a substantial advancement over the first plant at Osara which provided 500 units per year, all handmade.

National's steel-frame system for detached housing uses the Rhamen construction method of assembling light steel posts and beams on-site to create a rigid box construction. The first floor is constructed from modular wood panels supported on intermediate wood joists; wood panels on the second floor bear on a system of intermediate wood joists spanning lightweight open-web steel joists; and the hipped roof is framed in steel with wood purlins supporting sheathing panels. Exterior

Figure 5.1.11

National House Show Home, 1984

Figure 5.1.12

National House -
House 55

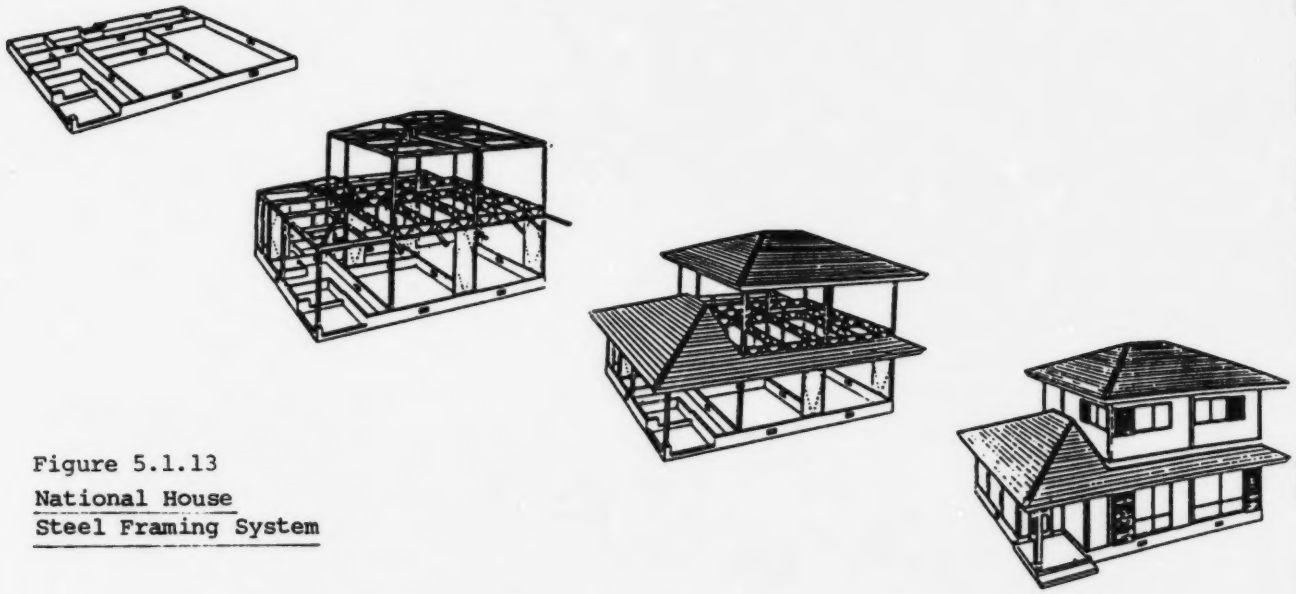
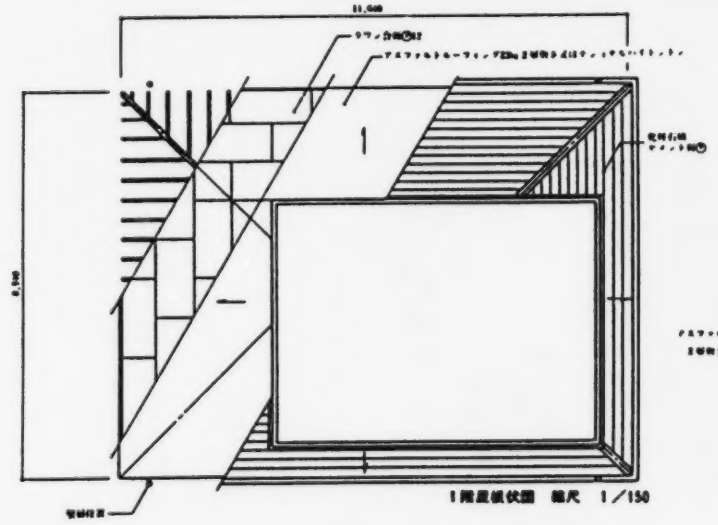
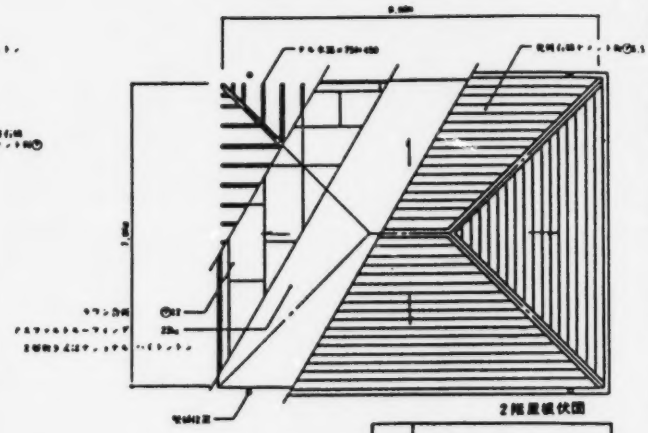
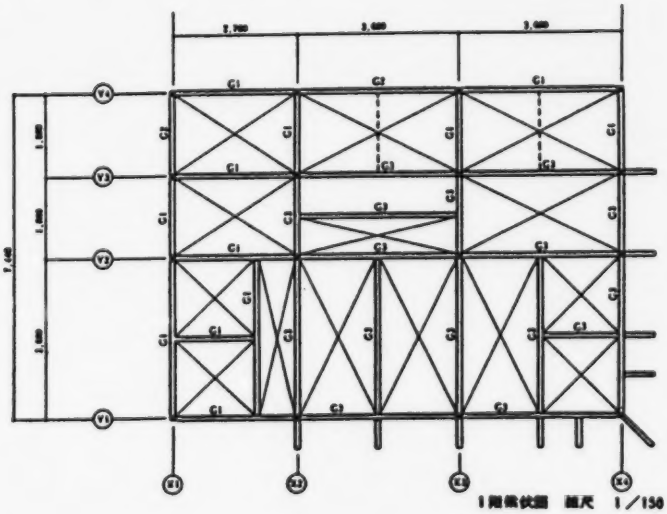


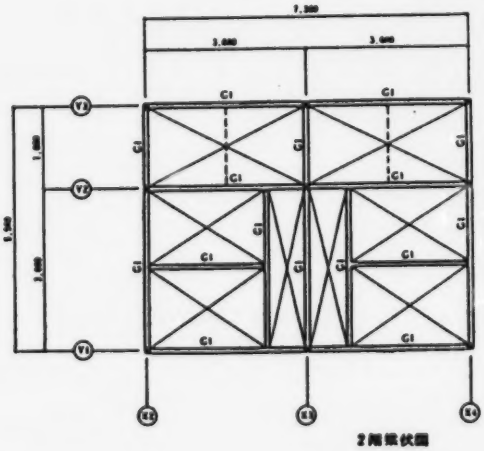
Figure 5.1.13
National House
Steel Framing System





G_1	ㄇ 2ア−160×40×2.3
G_2	I 2[−160×40×3.2
G_3	上下張材[−80×40×2.3 ラ チ ス[−75×35×2.3





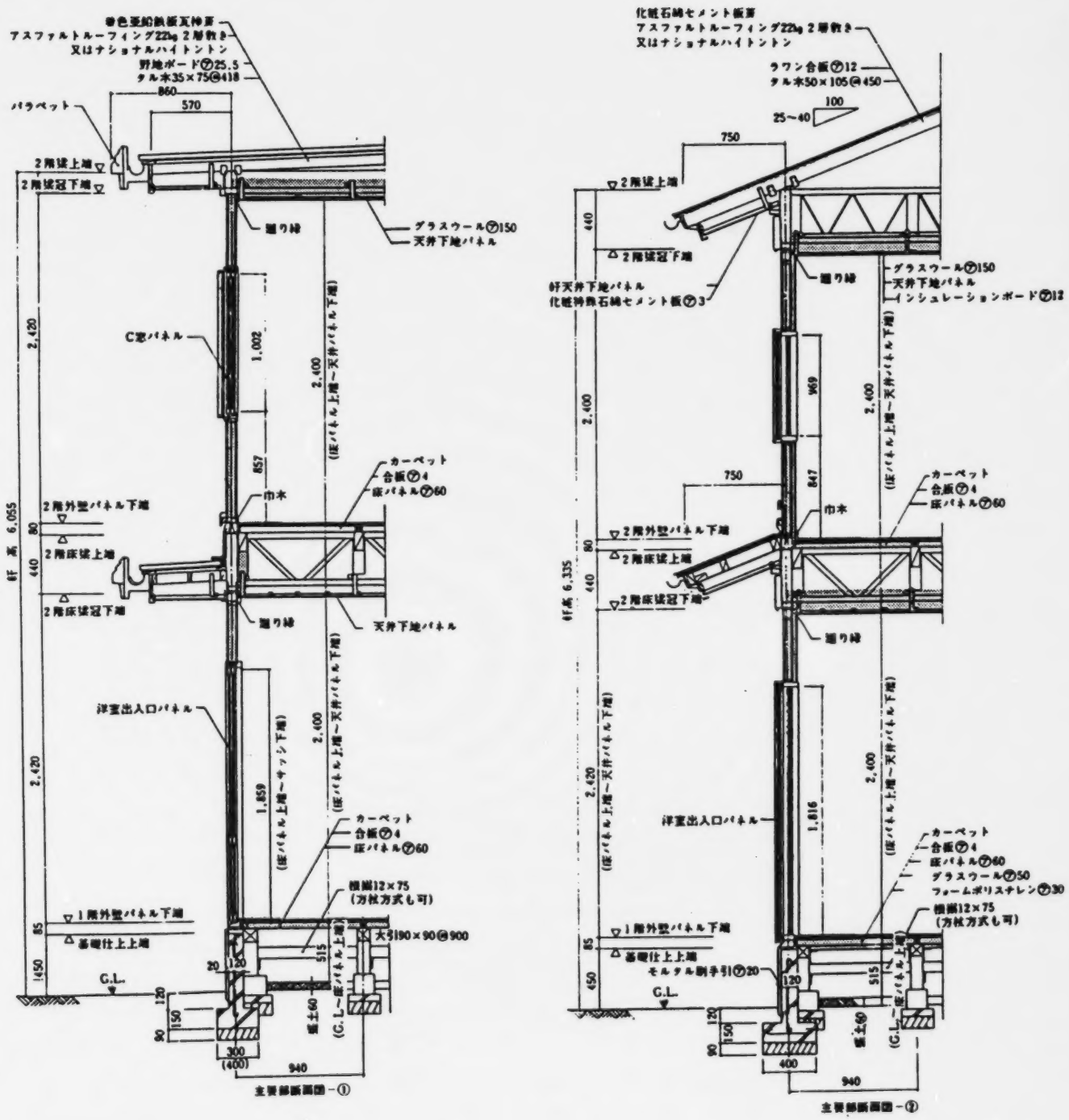


Figure 5.1.14
National House -
Typical Wall Sections

cladding is a large modular wood-panel system with integral steel frame, cement asbestos exterior cladding, batt insulation, and gypsum-board interior. A final exterior finish is applied on-site, typically sprayed stucco, and, similarly, interior walls and ceiling surfaces are finished on-site with vinyl wall covering. All windows and doors are factory installed in the panelling process. Electrical, mechanical, and plumbing is done on-site.

As a member of the Matsushita group and Japan's largest manufacturer of robotics, National's production facilities can boast some of the most up-to-date automated systems in the industry. Since starting their own steel rolling mill at the Koto factory four years ago (previously, steel frames were purchased from subsuppliers), the mill has been automated to the extent that a single worker can now control an entire production line 80 metres in length. Quality control throughout the fctory is achieved through use of microprocessors, and all machinery in the large panel production line is controlled through a central computer.

Each of National's factories is self-sufficient, in that each has the capacity to provide a full line of products, with the exception of windows and doors supplied exclusively from the Koto factory. Production levels for each factory are based on sales in their respective catchment area covering approximately a 250-kilometre radius. The Koto factory, the largest of the three, employs 100 factory workers with a total complement of 250 employees including administration, training centre staff, and production design and engineering staff. The plant operates with one daily shift from 8:00-16:45 hours, five days per week, with up to two hours of overtime per day.

Of National's total sales, 63 percent are building materials (housing components to dealers), 27 percent are direct sales of housing, and 10 percent are sales of housing lots.

Ninety-eight percent of all sales are in the Honshu area of Japan and sales in Hokkaido area have averaged only ten to twenty units per month. National House is not in the land business. It will purchase serviced lots from other real-estate companies for resale to customers, and this now seems to be the prevalent practice among most prefab housing companies. The firm emphasizes pre-sales and the free-style plan, and its involvement in speculative housing is negligible. Recent sales have indicated a trend to larger, high-quality units employing free-style design. National House hopes to achieve a break-even point of two thousand units with its sales of House 55, an increase of 65 percent from the current level of sales.

National uses the dealership program for sales of its products but maintains a direct interest in these dealerships through 50 percent ownership. The company also runs an extensive training program for its dealers and on-site assemblers at its training centre at the Koto factory.

House sales fall into three categories: houses on subdivided lots, replacement houses involving demolition of an existing house, and replacement houses where an owner sells an existing property and moves to another site (the last category is very limited). The most effective means of sales and promotion is the show home in show parks, and National has up to 260 show homes throughout Japan. Existing customers are also a prime source of new sales, and National estimates that 35 percent of sales originate from referrals from existing National customers.

In addition to National's strong commitment to House 55, continued research into new products and processes is an important function of the overall operation and is promoted at each factory. This research falls into three main categories:

1. development of improved shelter with concern for safety in the home, durability of materials and components, heat and fire resistance standards, and new hardware systems;

2. improvements of facilities that promote comfort and convenience in the home, including heating and kitchen and bathroom appliances and fixtures; and

3. increased understanding of user needs and consumer preferences.

This research reflects a basic philosophy of the company that new materials must be sought to increase quality and reduce cost on the supply side and a constant demand must be sought on the demand side to justify the large capital outlay for production facilities.

SEKISUI HEIM (SEKISUI CHEMICAL)

Sekisui Chemical founded Sekisui House in 1960 as an independent company specializing in prefab housing based on lightweight steel framing and a composite wall panel system. On the basis of this experience, and in response to the remarkable economic growth throughout Japan in the mid-1960s, Sekisui Chemical launched its second effort in the prefab housing field and started developmental work on its prefab unit house in 1969. Unlike Sekisui House Limited, which is an independent company, Sekisui Heim was established as a division within Sekisui Chemical Company Limited. This division now accounts for 38 percent of total sales of Sekisui Chemical, and building materials and housing equipment accounts for another 11.4 percent of total sales.

The largest shareholder of the parent company, Sekisui Chemical, is Asahi Chemical Industries, which in turn is the sixth largest producer of prefab housing through its Hebel House division. Major shareholders of Sekisui Chemical include:

Asahi Chemical Industries	16.2%
Dai-Ichi Mutual Life Insurance	6.5%
Sanwa Bank	4.5%
Daiwa Bank	4.1%
Tokio M & F Insurance	3.3%
Sekisui House	2.1%
Foreign Ownership	10.3%

Sekisui Heim ranks fifth among the top five prefab housing companies and fifth in the production of detached units, although annual sales of detached units are not far off those of Daiwa and National. Sekisui Heim has not been strong in the apartment field but sees advancement in this area with the introduction of a new, three-storey prefab apartment unit.

From the outset, Sekisui Heim pursued a prefab system that would reduce cost by minimizing on-site labour, increase quality control through industrialization of not only components but the entire house, and capitalize upon its experience in manufacturing various housing related products. Sekisui Chemical already had broad experience in manufacturing housing components such as buckets, garbage containers, PVC pipe joints, solar water heaters, septic tanks, and electric water heaters, and this experience provided invaluable insight into systematized plant production.

The welded box frame was selected to take advantage of lightweight steel and promote unit construction with the objective of manufacturing up to 90 percent of the house at

the plant production stage. The dimensions of the unit are 2.5 x 5.4 x 2.7 metres with a weight in the order of two tons. Each unit is designed to be independently constructed, and a high degree of flexibility and adaptability has been given to connection and opening portions. Panelling parts comprise four subsystems: side wall units, outer wall panels, floor panels, and roof panels. Interior systems consist of side closet, sanitary section, kitchen section, and stairway section. The production line is organized to produce these units in sequence at about five-minute intervals.

Sekisui Heim sees its unit house concept as representing the third stage of the prefab housing industry in Japan. The first stage of industrialization began with factory production of parts and materials, facilities, and equipment and was followed by the second stage with semi-finished products, as represented by precut and processed exterior wall panels and floor panels. The unit module represents this third stage, as it allows complete assembly and finishing of bathrooms, kitchens, living rooms, entrances, and bedrooms in the factory and reduces on-site work solely to assembly of these building blocks.

Of a total of six thousand employees in Sekisui Chemical, twelve hundred are involved in the prefab housing division of which four hundred are sales staff. The company has direct sales in the Tokyo, Osaka, and Nara regions and dealerships throughout the other prefectures, with a combined sales force of approximately one thousand spread across forty-four sales offices. All dealerships are owned outright by Sekisui Chemical. The largest dealer handles five hundred units per year and has eighty employees and the smallest handles thirty units per year. In the case of direct sales, on-site work and after-sales service is undertaken by employees of the company; dealerships use their own employees for this work, and in both situations subtrades are retained as required. Sekisui

Figure 5.1.15

Sekisui Heim Show Home, 1984

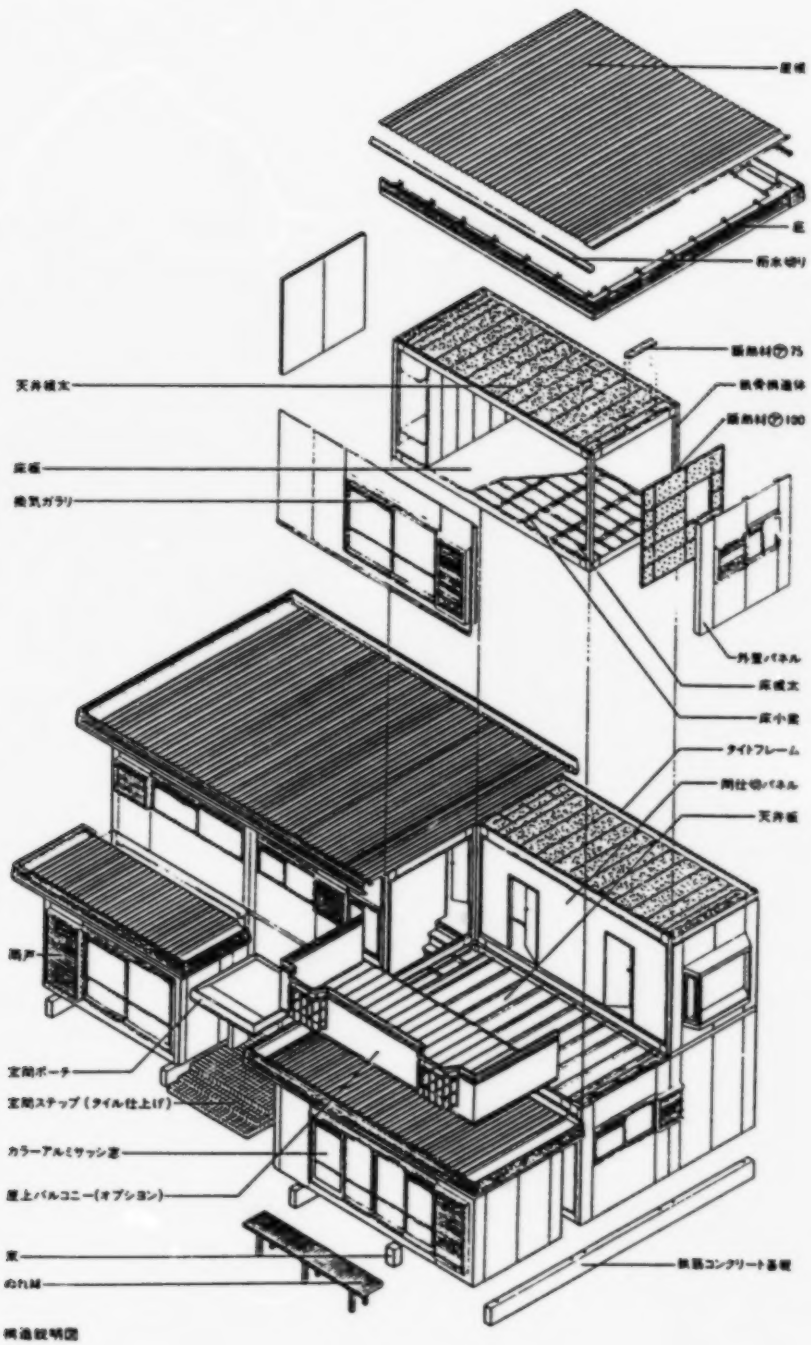


Figure 5.1.16

Sekisui Heim -
General Construction

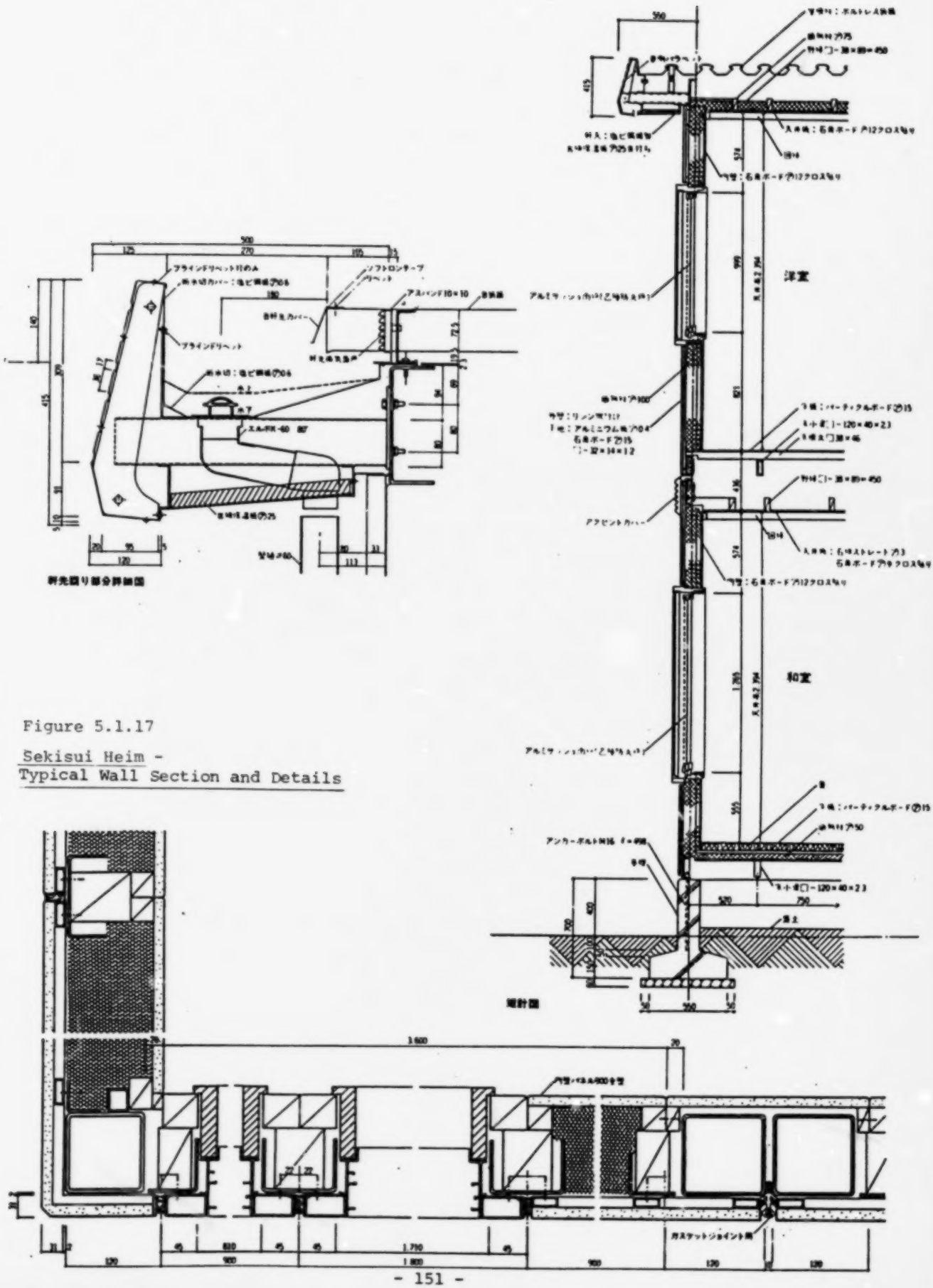


Figure 5.1.17

Sekisui Heim -
Typical Wall Section and Details

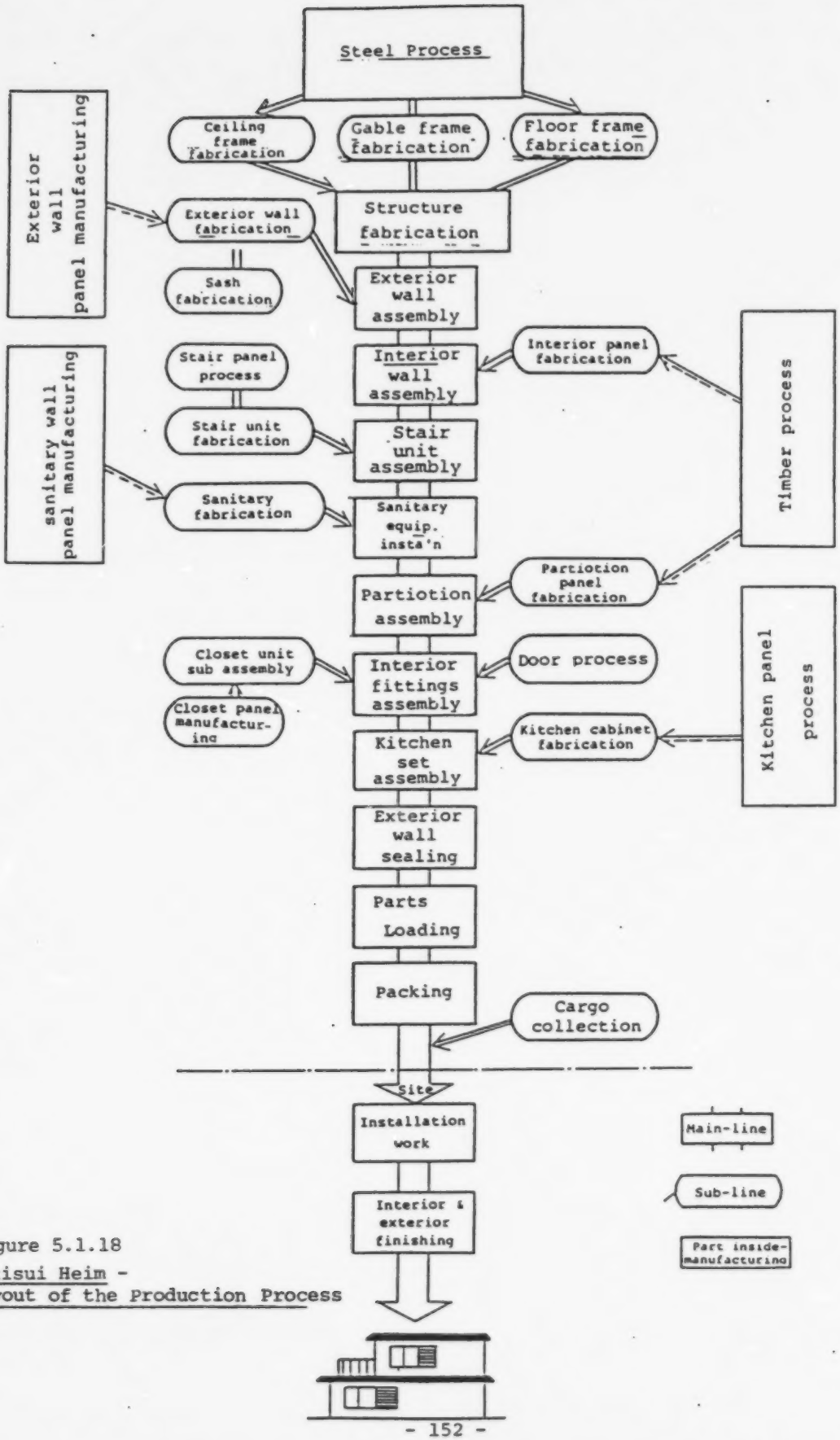


Figure 5.1.18
Sekisui Heim -
Layout of the Production Process

Chemical has recently established two new divisions for renovation and after-sales products.

Housing is manufactured at six locations, with a combined production capacity of one thousand units per month. The largest factory at Musashi has been in operation for over ten years and now accounts for almost 30 percent of total production capacity. This plant employs 430 persons in the housing division, with a production level of 4,200 unit components per month--the equivalent to 375 houses per month or 4,500 houses per year. Production is order-based and takes place on two production lines, each approximately 400-metres long and moving at a rate of 1.3 metres per minute. The completion rate is one unit component every four minutes. These production lines involve some thirty thousand different parts and 100 material or component suppliers.

Unit modules are manufactured in the factory, transported to the site, and installed by crane on a previously prepared foundation. The construction time on site will depend on the extent of interior and exterior finishing, optional and accessory equipment, site conditions, and the skill of local workers. Standard delivery time to the customer is forty days after installation of the units on the foundation. The breakdown of construction time for a typical 120 m^2 Sekisui Heim house is shown below.

Construction Time on the Site

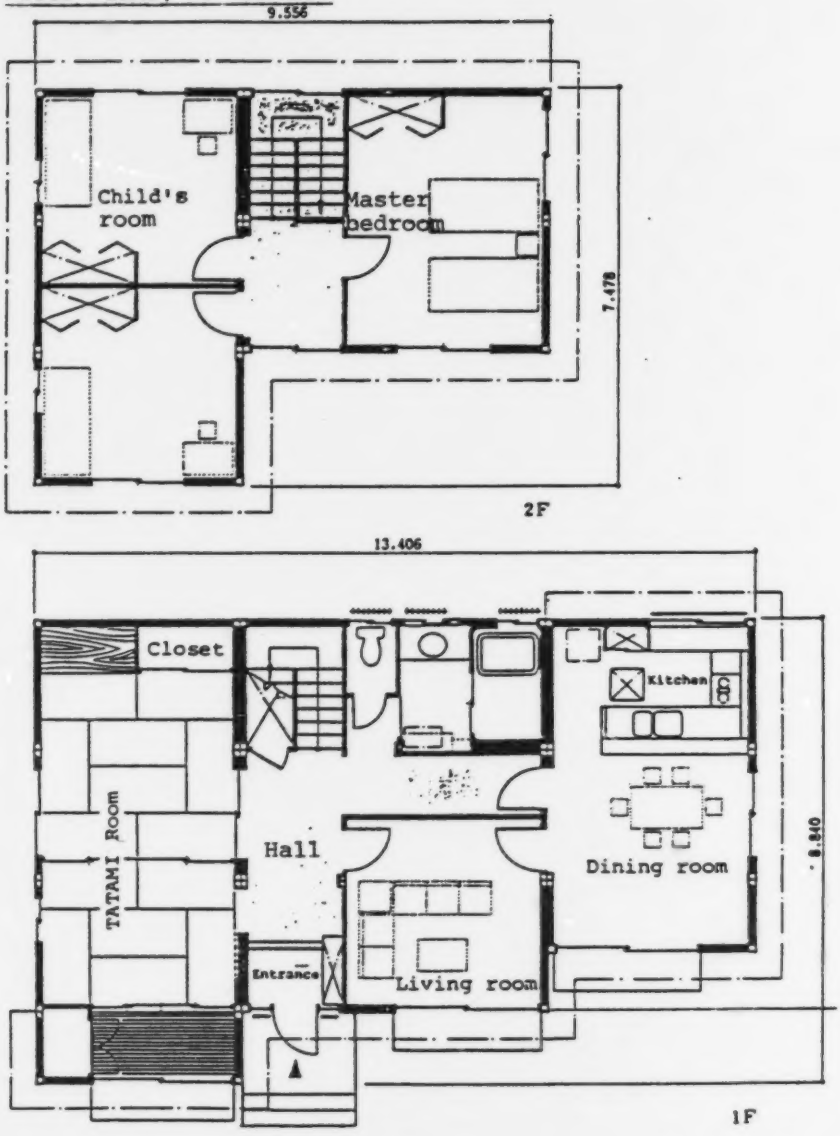
Process	Man Days	Remarks
Foundation	10	
Installation	9	Operator of crane truck is not included
Carpentry	13	Including interior carpentry, floor finishing
Interior	14	Papering, carpet fitting
Bricking	5	Entrance step, tile finishing
Indoor plumbing	4	Indoor water supply/ draining
Indoor electricity	2	Indoor electric wiring (between modules)
Clearance & cleaning	2	Site, inside house
Total	59 Man Days	

Outdoor installations of water and gas supply, electricity, site drainage, and other utilities and services as well as landscaping are not included in the above table.

The standard domestic price of Sekisui Heim's M3 PARFAIT model based on the plan shown in figure 5.1.19 is shown below. This price could vary depending upon grade of equipment and interior fittings, but it is an average price for the Japanese market.

Figure 5.1.19

Sikisui Heim -
Floor Plans, M3 Parfait



Total floor space 152.29 m^2

Ground floor 97.61 m^2

1st floor 54.68 m^2

	Per House
Factory manufactured material cost (including unit assembling, transport fees)	¥13,000,000
Site work costs (including foundation materials and plumbing supplies)	¥ 3,200,000
Total	¥16,200,000

Outdoor installations of water and gas supply, electricity, site drainage, and landscaping are not included in the above costs.

Sekisui Heim is moving into the renovation market with its trade-in program now getting underway. The company guarantees trade-ins and buy-backs of the modular units that comprise a house. The old house is removed from the site, stripped down at the factory, and returned to the production line to be assembled into a different model. The reclaimed house is either sold to the original customer, after deduction of the trade-in allowance, or turned over to the company's recycled home division, which foresees an increasing market for used homes.

5.2 Other Competitors in the Field

The top five prefab housing companies have a secure hold on 80 percent of detached prefab housing production, and there is no imminent threat from other known competitors. These other competitors are primarily the remaining five companies in the top ten list and account for an additional 13.7 percent of all detached prefab production. Unlike the top five producers, the ranking among the next five has changed considerably over the past seven years, with some companies disappearing entirely from the list and being replaced by new entries.

Of the remaining five prefab producers on the list, three companies, Asahi, Nisseki, and Kubota, use a steel-frame and panel assembly while Tessei is the sole precast concrete system among the top ten and Kobori joins Misawa with a large wood-panel system. Asahi and Nesseki rank fifth and sixth respectively in production of steel-frame detached units; Kobori ranks a very distant second behind Misawa in wood-panel production, and Tessei dominates the precast concrete market.

Both Asahi and Kobori deserve mention due to their recent successes, Asahi with the Hebel House and Kobori with House 55.

ASAHI CHEMICAL

Asahi Chemical stands out from the rest in this category by virtue of its strong growth and current production levels, and perhaps it should be included in the list of top producers. Since 1978 Asahi has climbed above both Tessei and Toshiba to rank sixth overall. In this same period its production of detached units has grown by 150 percent. No other company in the top ten list can match this record, with the next nearest growth record for the same period in the order of 26 percent by Misawa Homes.

Asahi Chemical Industry Company Limited ranks 130 in the Fortune ranking of international companies and is one of Japan's largest chemical companies with operations in fibres and textiles, chemicals, plastics and synthetic rubber, food products and medical supplies, and construction materials and housing. Asahi Chemical is also the largest single shareholder in Sekisui Chemical. In 1984 construction materials and housing accounted for 17.0 percent of total sales and Asahi Chemical has enjoyed continued growth of its Hebel House and other autoclaved lightweight concrete building products.

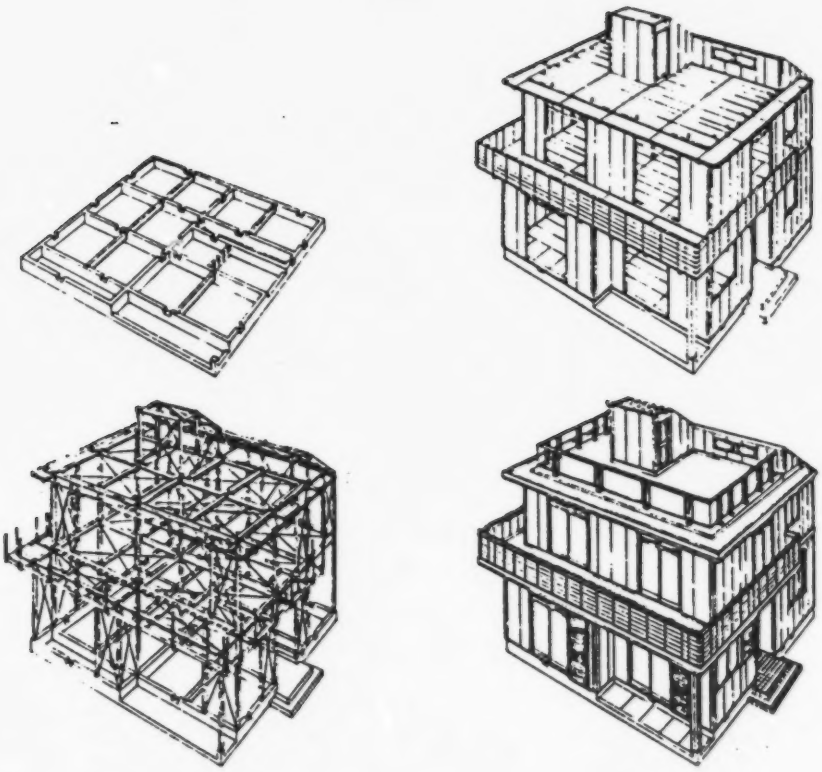
Asahi Chemical first began work with autoclaved concrete in 1961 and in 1966 concluded a technical agreement with Hebel Gastbetonwerk GmbH of West Germany for the production of Hebel products in Japan. In 1972 an independent housing division was set up within the company, along the lines of Sekisui Heim, with its own accounting and financial responsibilities under the divisional system. This housing materials division now accounts for five factories producing autoclaved products, each of which produces both housing components and building materials. Steel frames, windows, doors, and other components are subcontracted out, but, in turn, these factories also produce materials and products for other than housing and purchase materials from other divisions within Asahi Chemical.

The housing materials division has some fifteen hundred employees, including branch office staff with four hundred architects, engineers, and technical production staff, eight hundred in sales including show-home hostesses, and the remainder in administration. There are some one hundred show homes throughout Japan and eighteen sales offices of varying size. The company has concentrated on sales within the denser urban areas, where the combination of steel frame with autoclaved concrete provides excellent earthquake and fire protection. Total sales in 1983 were 4,730 units, and the sales system is exclusively direct sales with all staff being company employees.

The Hebel House has been characterized by its flat roof and somewhat European appearance. The company has consciously pursued the two- and three-generation large house in the higher end of the housing market. Therefore, a typical unit has been both larger in size and more costly than its prefab competitors. The average unit size has grown from an initial 99 m^2 up to 116 m^2 in 1978 and now is in the 132 m^2 range. In fact, these larger and more costly units have given the Hebel House a much higher sales volume than would be apparent when comparing only unit production.

Figure 5.2.1

Asahi Chemical Show Home, 1984



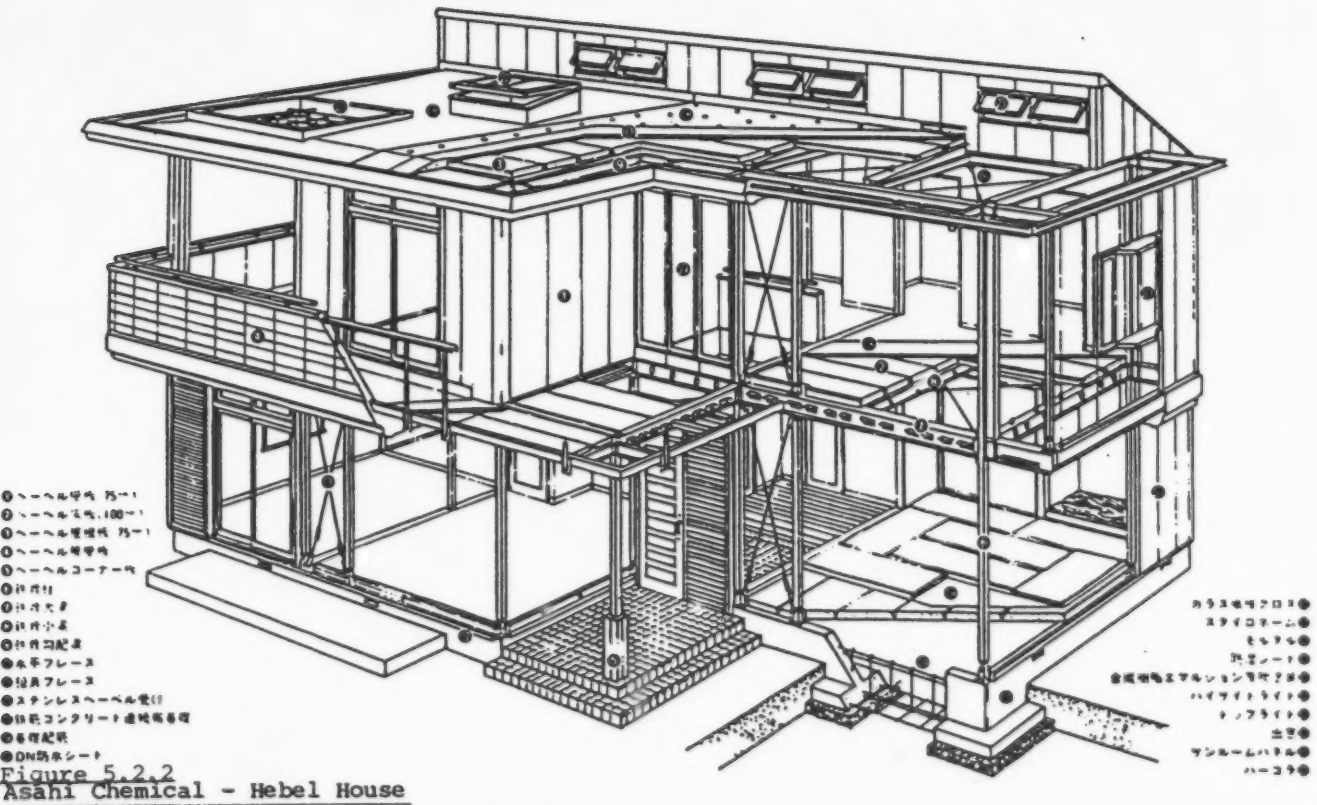


Figure 5.2.2
Asahi Chemical - Hebel House
Steel Framing System and PALC Panel System

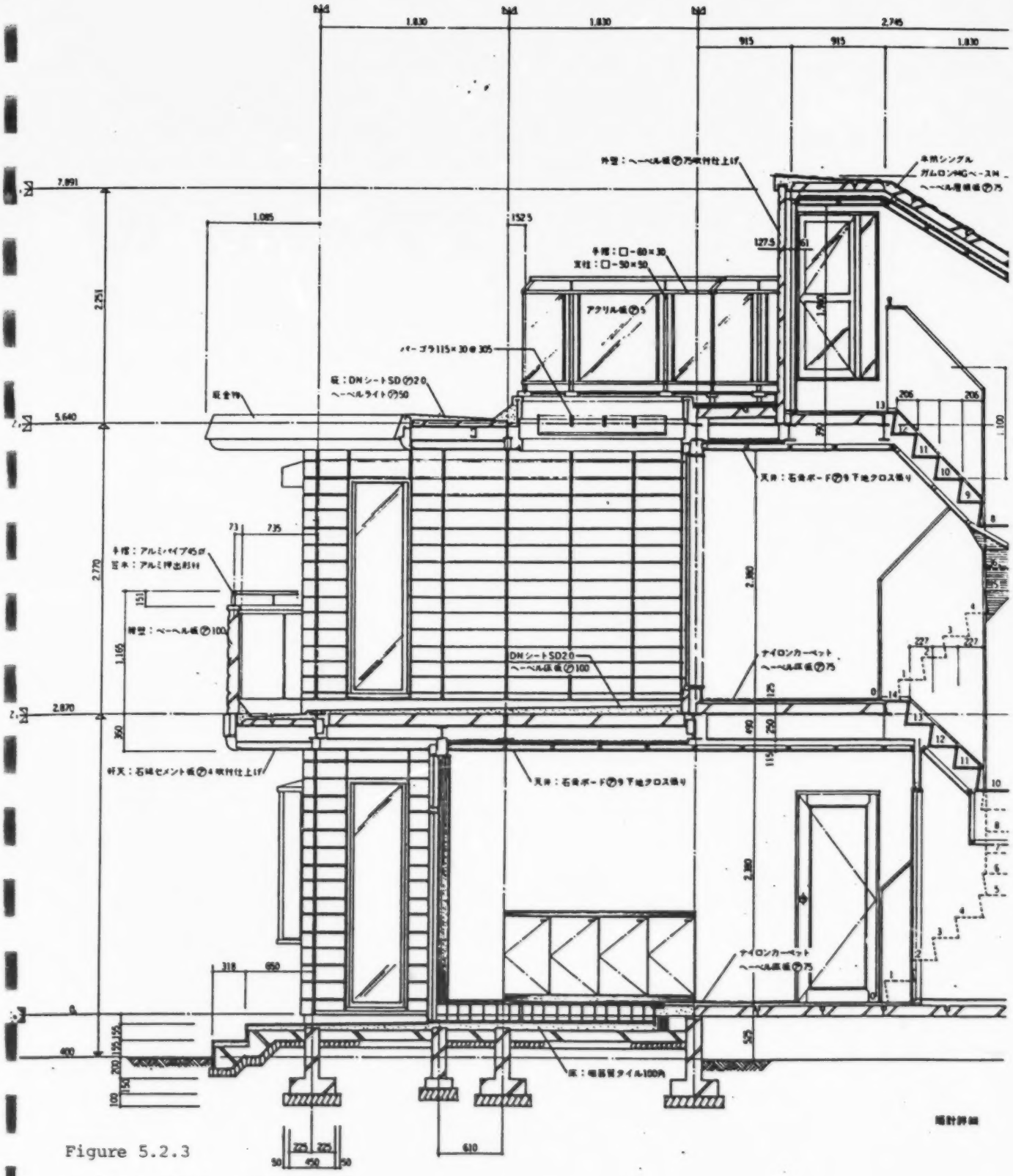


Figure 5.2.3

Asahi Chemical - Hebel House
Typical Wall Section

Two recent changes have modified the standard product and increased sales in urban areas. First was the introduction of the sloped roof, replacing the flat roof, in 1979. There is now a distinct preference among higher income purchasers for the sloped roof, whereas the flat-roof design has been retained for the lower cost lines. Second is the introduction of three-storey houses for better use of expensive urban land. Along with the addition of a third floor have come modifications to the steel frame itself, removing diagonal bracing and minimizing internal columns in an effort to promote commercial uses on the ground floor and larger wall openings.

The Hebel House is constructed on a steel frame supported on a continuous reinforced concrete footing. The frame is comprised of I-section columns, girders, and beams with diagonal bracing both vertically and horizontally. Decking for floors and roofing is autoclaved lightweight concrete (ALC) with a light concrete topping poured on-site over all floors. The outer walls use a 75-mm thick ALC panel with a 110-mm air space and a 9-mm gypsum-board interior finish. Panels come in a range of sizes, and, with the emphasis on the free-style plan, modules are now based on a 30 cm width (12 inches). The heating system uses a floor plate with hot water veins installed below the carpet.

This prefabricated system has had increasing appeal within dense urban areas due to its durable construction and exterior finishing, excellent soundproofing qualities, and high rating in earthquake and fire resistance. However, it is not well suited for apartment use, and apartments account for less than 5 percent of total sales. On the other hand, Asahi Chemical is enjoying a significant market share in terms of total sales as compared to unit production figures.

KOBORI JUKEN

Kobori was founded in 1951 and has operated exclusively in housing and real-estate sales since that time. In 1984, 87 percent of its sales were order-built houses, 11 percent were ready-built houses, and 2 percent were ready-built condominiums and apartments. Kobori has clearly established itself as a leading builder of order-built or free-style homes, using the large prefabricated prestressed wood panel, and now hopes to expand sales of ready-built or fixed-plan homes through its involvement with House 55, also using its wood-panel system.

Kobori started with a traditional wood house and sold the house and the land, using a limited number of fixed plans. In 1967 they ventured into the prefab wood-panel system and opened their first panel factory in 1971, but through 1977 they continued to offer both a prefab and a traditional wood house. Today, Kobori has two wood-panel factories with a production of 1,604 detached units (1983). These factories are established as independent companies although 100 percent owned by Kobori. In addition, the company operated nine branch offices and seven sales offices throughout the country.

Of a total of almost 600 employees, approximately 250 are in sales as Kobori relies exclusively on a direct sales system, eighty are in engineering, architecture, and product design, eighty are technical staff, twenty are involved in research and development, one hundred are factory workers, and the remaining 60 are administrative staff. The company operates forty-eight display homes which provide the main source of sales--some 60 percent, with 20 percent arising from customer referral and 20 percent from media advertising. The free-style plan is still the most popular product, and although it accounts for only 50 percent of unit sales it

provides 65 percent of sales income. House 55 represents 35 percent of sales income although it has risen in unit sales and expects to achieve a level of one hundred units per month. On a square-metre basis the free-style plan is 37 percent more costly than House 55.

Approximately 90 percent of sales are the house only, and Kobori has reduced its speculative product, including sale of the house and the lot, to less than 10 percent. Over half of all sales are to couples in the range of thirty to thirty-five years old. Current factory production averages 150 units per month (eighteen hundred annually), but this could be increased to two hundred per month or twenty-four hundred annually. Factory inventory is maintained at a two-week supply of panels, equivalent to 75 units. Each house requires 130 to 140 panels from among some 140 varieties by size and type. Shipping normally requires two eight- to ten-ton flatbed trucks and covers a 500-kilometre radius.

It is estimated that the in-factory labour content of the Kobori system is in the order of 20 percent, in contrast to Sekisui Heim which has the highest ratio at 80 percent. The prestressed wood panel is essentially the only prefab component in the Kobori system with all other work being carried out on site. The system uses a series of large, two-storey prestressed wood panels for the exterior walls; prestressed panels bearing on open-web steel joists for the first and second floors, and wood rafters for the hipped roof.

An air space is maintained between the insulation and the exterior skin by the installation of a patented "egg-carton" grid, and continuous air movement is maintained throughout this air space by vents along the perimeter of the foundation and along the ridge of the roof. This air-circulation system distinguishes Kobori's panel construction and provides an effective means of coping with the moisture problems that have plagued a number of other exterior wall-panel systems.

Figure 5.2.4

Kobori Juken Show Home, 1984

Figure 5.2.5

Kobori Juken -
House 55

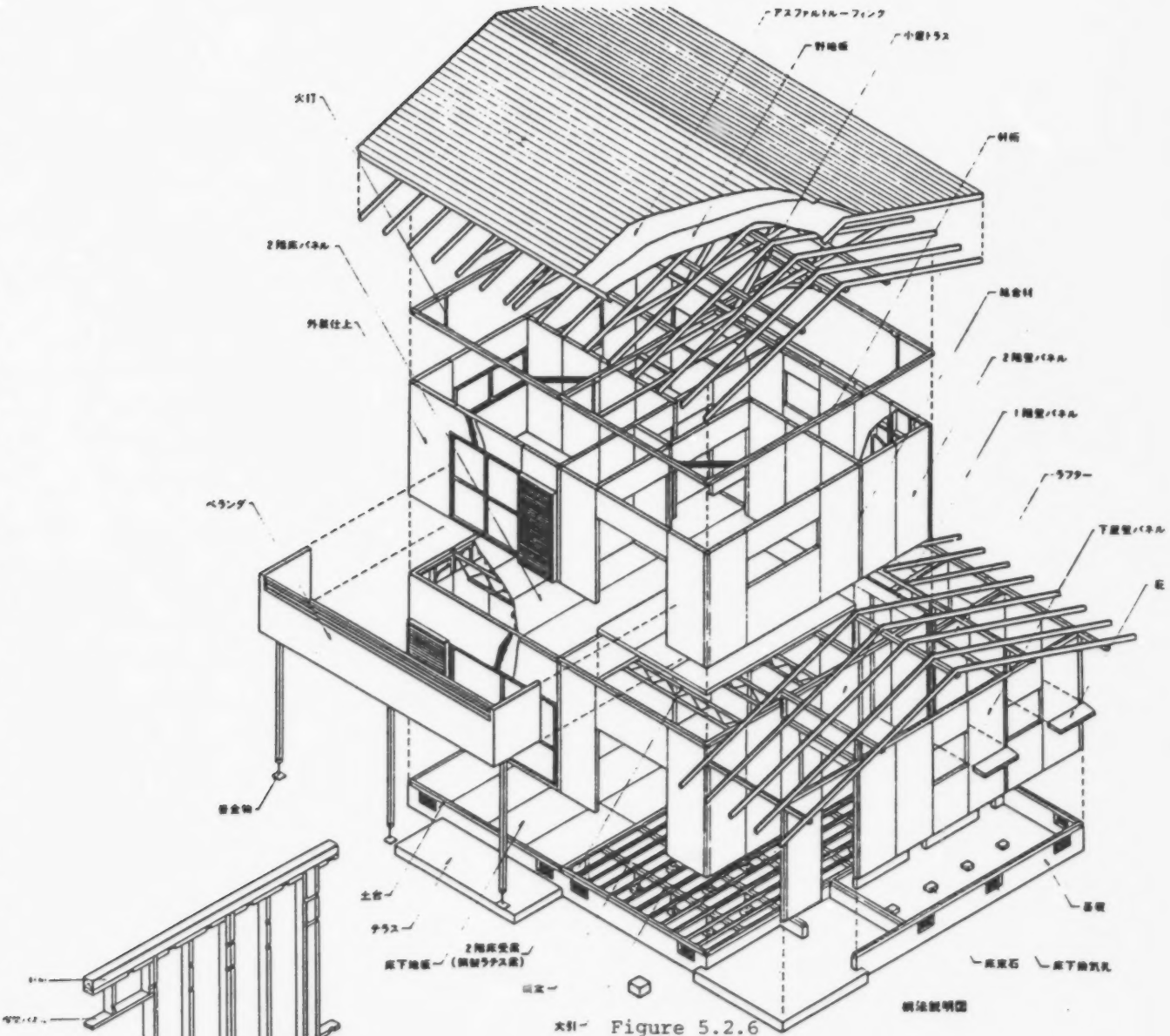
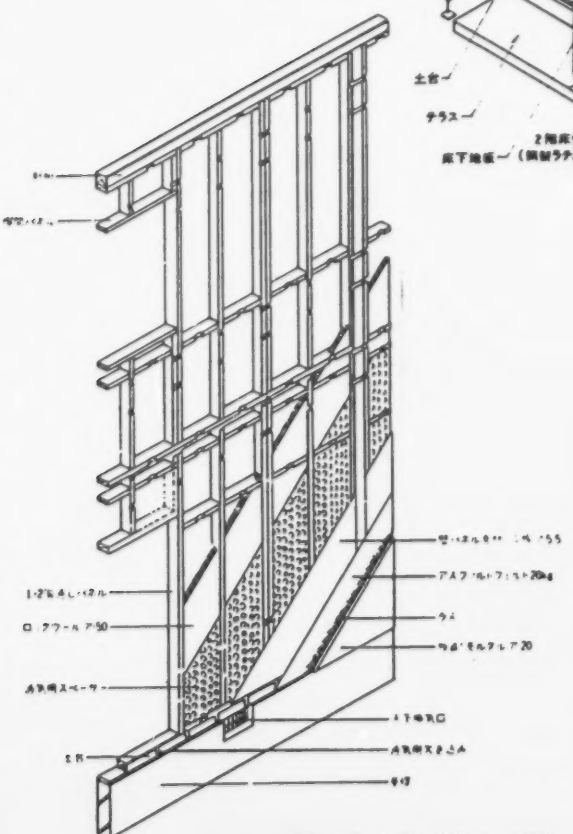
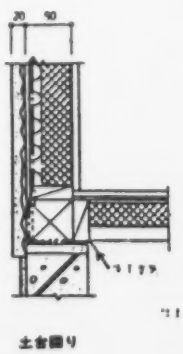
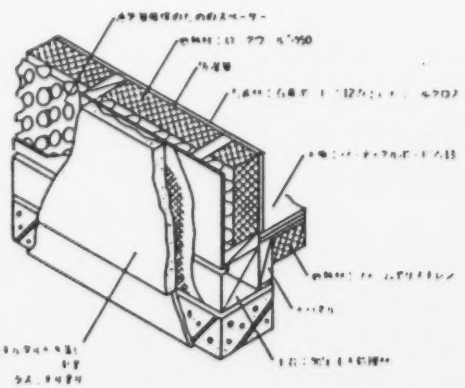


Figure 5.2.6

Kobori Juken -
Prefabricated Wood-Panel System







5.3 Foreign Activities and Overseas Subsidiaries

Post-war Japan has always oriented its domestic manufacturing mix to the global patterns of trade and foreign investment. Even though exports comprise one of the lowest percentages of GNP of any major Western nation (10 to 11 percent of GNP, compared to 8 to 9 percent in the U.S., 25 percent in Canada and Britain, and 40 percent in West Germany) in manufacturing alone, the Japanese rate is about 50 percent. Why should the products of the prefab housing companies not follow the same trends we have seen of so many other products of Japanese industry?

In spite of the obvious levels of comparative achievement within the Japanese prefab housing industry, there is little if any evidence of an ability to move beyond their own shores and challenge housing markets in other countries. Daiwa House has set up subsidiaries in California and Texas, but only to produce 2 x 4 houses in a manner identical to an American builder and reportedly without the profit margins Daiwa are accustomed to. Now Daiwa is actively pursuing the Chinese market, but this venture is still in its infancy. Sekisui House established a subsidiary in West Germany but after substantial losses entirely abandoned the venture. Misawa has sold rights to its PALC system to South Korea and China and foresees increased overseas sales of its patents through licensing agreements. On one hand, Chiyoji Misawa is most optimistic that he can increase foreign sales but, on the other, Masaru Tanabe, President of Sekisui House, clearly feels that it would be difficult to compete internationally against 2 x 4 construction.

There would appear to be four significant deterrents to increasing foreign activities for the major prefab housing companies. First, and perhaps foremost, it would be virtually impossible to duplicate the market conditions enjoyed in Japan.

Where else might one find a similar geographic concentration of people at such high densities and centrally located in the country? This is a market for housing independent of land in the majority of cases, with a heavy component of rebuild units and subject to severe earthquake and fire hazards. Second, the heavy reliance on steel components by the majority of prefab housing systems would be a significant disadvantage in cost and shipping weight in the countries that do not enjoy Japan's edge in steel production. Steel, for a variety of reasons, is not a suitable residential building material in North America and Europe.

Third, the capital investment in factories and equipment is substantial, and it is unlikely that foreign countries would be prepared to offer comparable financial incentives such as the loan arrangements through the Japan Development Bank. Certainly, the North American market would not offer anything comparable to the level of government support enjoyed by these companies on their home territory.

Finally, it has yet to be proven, even in Japan, that prefab housing systems can compete head-on with 2 x 4 construction. Until the prefab housing companies get a better understanding of the prospects for 2 x 4 construction in their own country, they are not likely going to face this competition on its home territory. Perhaps Mitsui and Mitsubishi soon could be in a better position to exploit foreign housing markets than the prefab housing companies.

What Japan may export is not the products of their Japanese assembly lines but the knowledge they have gained in refining these products and selling them in their marketplace. In addition to licensing agreements for particular procedures and products, the Japanese could explore the transfer of their franchising operations, after-sales service programs, approaches to home renovation, or even the managerial or

organizational systems. We can hope we will learn to look at more than the welding robots and nailing machines, for these will not likely constitute the major export items if the top five prefab companies explore other market possibilities.

At this stage, the Japanese prefab companies are a domestic industry exclusively, with great prospects for growth at home and perhaps abroad. But the prospects are best on the home front, and foreign markets are not as attractive as some first thought.

6.0 A COMPETITIVE FUTURE FOR INDUSTRIALIZED HOUSING

6.1 A Paradigm for Success

It is impossible to view but a small part of Japanese industry in a decidedly short time and profess to understand what is universally recognized as a complicated and complex industrial system. This is a system that is competitively developing new products, services, and technologies equal to the best available anywhere in the world, not to mention the plethora of books that offer insights into their business world from every conceivable perspective. This work has not attempted to draw conclusions as to the relative merits or demerits of the Japanese system of industrialized housing as compared to others. The intent has been to observe that enormous capacity to develop skills and capabilities in the field of housing and to examine the Japanese successes with industrialized housing. Hopefully something can be learned that will be applicable or relevant to the way that Western society may improve the quality of its living environments.

While consumer preferences in Japan have a marked tendency toward North American trends, certainly in the field of housing, very different market conditions do exist and, therefore, the context for the housing industry in Japan shares little in common with its counterparts in America or Europe. While there are the obvious reasons for such differences, including the land scarcity, high urban densities, social structure of the family, and other cultural factors, one could also mention some of the more typical reasons that the industrial analyst may cite. These may include the Japanese banking system, the relationship between government and industry, consultative decision-making, or even small business subcontracting. What is surprising is that in spite of such disparities, there is a striking resemblance between the operations of the small residential contractor who has been the

backbone of the housing industry both in Japan and North America.

Industrialized housing in Japan was not a logical extension of, nor did it emanate from, the traditional home-building industry in that country. In fact, its present strengths lie not in its ability to compete with the traditional home builder but to satisfy a unique set of market conditions that have emerged since the war and that the traditional house builder could not or would not satisfy.

Prior to discussing the discernible characteristics of the Japanese industrialized housing sector, two points should be kept in mind, for they exemplify conditions that may apply only to Japan. First, any discussion of industrialized housing in Japan deals almost exclusively with the efforts of only five very large corporations who have amassed, by North American standards, great financial, human, technical, and organizational resources in an almost cartel-like fashion. These five companies are not typical of the some one hundred thousand small companies that still dominate the house-building industry in Japan.

Second, the notion of profitability within these companies is difficult to measure by North American standards and may be somewhat illusionary. On one hand, there is strong and sustained government support for industrialized housing, and the extent and scope of this support is difficult if not impossible to discern. On the other hand, the companies operate in an apparent competitive battlefield so typical of Japan's domestic industries and lay claim to profitability in the marketplace as the reason for their survival. It is virtually impossible to reconcile the notion of profitability in industry amidst the levels of government support and subsidy, irrespective of the other factors that may distort the profit picture in Japan. What is clear is that industrialized

housing is big business in Japan and begins to mirror the same arrangements that we have come to expect with other consumer goods that Japan has offered to its world markets.

Industrialized housing in Japan is a product that sells well in densely populated urban centres in two forms, the detached house and the small two or three-storey walk-up apartment. Success in rural areas, small towns, or remote locations is notable by its absence. In almost every case with detached houses, the unit is replacing a substandard traditional house on an awkward and confined lot that has remained in the family and is passed on through generations. Industrialized housing has virtually nothing to do with the land-development business, and almost every purchaser of a house or apartment has the land in hand. The need is for a house that can be tailor-made for a particular lot configuration, placed on the lot with a minimum of on-site labour since there is no space for storage of materials, and be built of materials that can meet rigorous earthquake and fire-protection standards. There is seldom sufficient developable land for assembling these houses on single sites or to facilitate the sequencing of on-site trades. Therefore, it makes more sense to aggregate and maximize factory labour and thus minimize on-site costs on these widely scattered sites.

Coupled with these advantages has been the penchant for quality required by the Japanese customer and achieved through in-factory quality-control circles; the move toward custom designs via the latest achievements in one-of-a-kind assembly lines and production techniques; the reduction in costs through such as-required inventory control systems as Kanban; and the short-term product development and improvement through research activities.[11] Not surprisingly, the housing products from

---

11. Kanban is an inventory and parts delivery approach which combines just-in-time delivery and a rigid scheduling flow to reduce waste and inventory costs.

these prefab housing companies are moving to the higher price ranges, and these producers have long overcome the stigma that Japanese home buyers first associated with mass-produced housing and that North Americans still do. Success is now on their doorstep, and sales figures are a testament to a proactive industrial policy that has reshaped this industry over the past two decades.

The contrast of Japan to the experience with industrialized housing in North America is profound. Surely the differences in market conditions and government posture alone cannot account for the seeming disparities in the experiences between the two.

Historically, the North American housing industry, and perhaps more so government, has sought to introduce technology or so-called industrialization into housing production as a panacea for various problems, most of which have to do with housing quantity and lowering housing cost. Operation Breakthrough, launched in early 1969 by the Secretary of Housing and Urban Development in the United States, stands as the most noticeable failure. This program's objectives were described as follows:

> This program has as its primary objective the establishment of self-sustaining mechanisms for rapid volume production of marketable housing at progressively lower costs for people of all income levels, with particular emphasis on those groups and individuals who have had difficulty in obtaining satisfactory housing in the past.

Inherent in the Operation Breakthrough approach is an undeniable faith that technology can "push" and that somehow with new hardware the same industry can achieve the necessary "breakthrough" in housing expected of a highly industrialized nation. The Japanese, on the other hand, have long since recognized that, whether dealing with domestic or foreign

markets, demand must also "pull"; technology alone cannot "push". Demand must first be created for products which can then be manufactured with improved quality and at competitive prices through the application of new technologies and industrial processes. Coupled with the admission that new gadgets or quick fixes cannot do the job alone is the recognition that both hardware and software technologies must be combined at both the micro and macro levels to meet any new challenge. Sales and marketing, after-sales service programs, employee training, or other personnel programs are every bit as strategic as the welding robots that may accompany new production lines.

The many foreign visitors to the Japanese prefab housing companies are seemingly missing the point. Nor are the Japanese making it easy when they direct these tours to particular factories with assembly lines that are clearly set up to impress the visitor, complete with painted route markers on the floor, display panels in English, and audio-visual presentations. Seldom is it mentioned that, while an entire assembly line may be computer controlled by a single employee, more than 35 percent of the staff may be involved in the field in sales and marketing. This facet of operations is every bit as sophisticated as the technical production methods on display. The visitor is not directly encouraged to discuss the organizational structure of the company, investment in sales and advertising, marketing strategies, or even the cost of operating a show home in a Tokyo home park. No doubt the Japanese, gracious hosts that they are, have responded to what the foreign visitor asks to see, and this has only reinforced the myth of Japanese technology and skewed the North American perception of the industrialized housing sector in Japan, as recently reported by our various trade and business journals.

The prefab housing companies have certainly given their customers the right story and have convinced Japanese consumers, as recalcitrant as they first were, that industrialized housing means better quality and increased durability at reduced costs. They have placed the first priority on the demand side and allowed this to pull the supply side into the desired position. These five companies have demonstrated an exacting skill in determining what to sell, as well as how to sell it. As the domestic market for industrialized housing evolves, it may well set a standard for quality, price, and reliability such that traditional Japanese housing producers and hopefully foreign companies alike will face new ground rules and challenges from housing consumers in the years ahead.

The changing perception in Japan of mass-produced housing is not unrelated to a fundamental change in production methods that are already far advanced in Japan and barely accepted in North America. Attempts at mass production in North America are still predicated on the foundations of the American manufacturing system that is well suited to the sequential production of relatively simple, imitative, and not very capital intensive products which can be assembled from man-made and largely interchangeble parts. Product lines are standardized, variety is minimal, and demand must be somewhat constant. Within this context, merely relying on new product technologies like ceramics or replacing human resources with new process equipment such as robots will not suffice. The Japanese are moving rapidly toward an industrial production system that is demand-fed, is capable of producing one-of-a-kind products in a sequential process, and has real efficiencies that do not penalize but reward human resources.

Industrialized housing in so many parts of the world has relied on "look-alike" products, espousing high volume at low cost that had little to do with real or private market demand and a great deal to do with solving production levels for publicly sponsored housing. Even the mobile home, in spite of serious attempts to camouflage its appearance, has not overcome widespread community resistance in this country. Experiments with other forms of industrialized housing in North America always seem to be geared to the low end of the market, various forms of multi-family housing, or some government-sponsored incentive program. On the other hand, the Japanese prefab housing industry extols the virtues of custom-designed detached housing, the free-style plan, and, in fact, can offer greater flexibility in layout, design features, and use of materials than the traditional Japanese hand-crafted builder. If the mobile home is the standard trademark of industrialized housing in North America, the large custom-designed urban home is rapidly assuming the comparable trademark for this industry in Japan.

An emphasis on particular production techniques or technologies already developed and refined by the Japanese is both misleading and short term in effect. It would not be sufficient to adopt new technological production methods and their commensurate management systems simply to advance the art of industrialized housing on this continent. The Japanese now operate on the basis of vision and self-confidence. Unless our housing industry is prepared to share this vision and address its implications, all the hardware and software that the Japanese could make available will not match the task.

The real message from Japan is the shift in the way that they now think about housing. This is a recent development and attributable, if not directly to the prefab housing industry, to the large corporations that in turn control these housing companies and themselves manufacture a host of consumer goods

geared to the home, from garbage cans to video display units. The prefab housing industry in Japan is oriented to marketing total living environments, not just buildings, and includes appliances, furniture, fixtures, and equipment. It views itself as having a contining involvement with its customers in changing, modifying, and adapting the home following its initial sale. After-sales activity is now an important part of the industry, and these prefab housing companies have shrewdly realized that the initial sale is only the beginning of a long and profitable relationship between producer and consumer.

Arising from this vision is the concept of differential rates of obsolescence whereby the structure, interior partitions, kitchens and bathrooms, furniture, floor and wall coverings, and appliances all have different life cycles, for a variety of reasons ranging from style to actual product deterioration. With some thirty years of experience behind it, the prefab housing industry in Japan is now equipped to move well beyond providing four walls and a roof and has positioned itself to take full advantage of the house as a consumer product, inclusive of all the equipment and facilities that a consumer requires to shape a house to individual tastes and preferences.

Obviously, this approach requires an organizational structure that extends far beyond what we normally deem to be a housing company. The totally integrated approach used by the five prefab housing companies is perhaps far more startling than the industrialized production process found within their factories and is reminiscent of what consumers expect when they buy an automobile. The comparison is not coincidental. Sales and marketing techniques were first borrowed from the automobile industry; direct and indirect franchising systems are every bit as sophisticated as those found in the fast-food industry; and training of sales staff and service personnel is likely equivalent to what we expect of IBM and Xerox. This

integration, or we could call it "rationalization" of the supply side, is geared toward satisfying as many of the consumer's expectations of the home as possible--veritable one-stop shopping. This reflects a level of progress within a housing industry that we in North America may still only dream of amid our historically fragmented and disjointed means of housing production and delivery.

Without diminishing the achievements of these five companies and their lesser colleagues, recognition must be given to the positive alliance that has been forged between government and industry to secure such achievements. Government has defined a role for the prefab housing industry, reflected this potential in its five-year housing programs, and no doubt saw it as a complement to, and not a replacement for, the traditional home builder. This commitment was backed by a series of programs through MOC and MITI and related funding through the Japan Development Bank to secure and strengthen the position of the companies in the prefab housing market. However, this policy was also viewed as a way of indirectly strengthening the traditional housing industry which even today remains the first priority of government.

The wide fluctuations in annual housing starts, characteristic of both Japan and North America, have placed great stress on the small builder in both countries, particularly during times of excessive peaks and declines. In the late 1960s, it became increasingly evident that such variations could threaten the long-term viability of these traditional builders, whose fortunes were at the mercy of the economic cycles that dictated housing trends. With government funding, the prefab housing companies secured an industrial capacity well beyond immediate requirements, and it was felt that upward demand pressures could be borne by the prefab sector with minimal cost and labour impact and thus could provide the traditional builder with a measure of production stability. This policy has yet to

be tested and may never be, in view of the overall downturn in housing starts that will likely continue well into the 1980s. However, it does represent a line of thinking quite contrary to what one might expect in North America, whereby industrialization would imply somewhat constant production levels and certainly not the degree of flexibility sought in the Japanese prefab industry.

Government also viewed the prefab housing industry as a convenient vehicle to promote privately sponsored research and development in a sector neither capable nor known for its research productivity. The traditional home builder could not be expected to fulfill such a function. There is a distinct misconception that Japanese government provides an inordinate amount of direct research funding for new technologies that other governments either cannot afford or do not provide in principle. The actual funding figures do not substantiate this claim. Government participation in research and development spending in Japan is lower than any other Western country, partially as a result of limited military spending. What is different in Japan is how government bureaucracies can marry public investment in new technology to commercial market needs, which in turn can be targeted to particular market sectors. Such is the case in the prefab housing industry with, for example, House 55.

The prefab housing companies are now promoting enormous research budgets compared to the traditional housing industry. It is estimted that the top five producers spent $76 million on research between 1976 and 1980. All of these funds are essentially directed at product development with relatively short-term results. Now, there is growing evidence that this investment in research and development will become the backbone of foreign ventures and patents and royalties will become future income generators. Furthermore, management and organizational skills--not materials and capital--will be the key to developing comparative advantages in offshore markets.

The recent success of the prefab housing industry in Japan is not a flash in the pan. It represents the maturing of an industry after almost thirty years of patient but nurtured evolution. The industry has combined innovation at all levels, and its competitive advantage stems not only from skill in production but also in marketing, sales, and after-sales service. What one sees today is not so much a refinement of past experiences but a totally revamped industry that has come to terms with changes in people's perception of what they will expect from a house purchase in the very near future. The five companies have indeed defined the terms of competition in the future, and these terms may well be those upon which we shall have to judge our own fortunes in what are still domestic and even regional markets.

6.2 Some Things to Think About

There is uncommon unity on one subject--Japanese economic success. No matter what Japanese product one chooses to investigate, the question is roughly the same, "How do the Japanese do it?" Of course, the next question is "What does this mean for us?" Their competition in foreign markets has shaken many industries, been the demise of others, and has provoked fear and protectionism throughout Western industrial economies. What then might be in store for our own housing industry as a result of the Japanese experience with industrialized housing?

Four things come to mind. These are speculative at best but deserving of future thought and consideration. First, even if the Japanese housing industry does not enter the global housing market directly, and there may be good reasons why it should not, its influence is bound to be felt in the way that North American home builders choose to do business in the future. For the first time in decades, and in spite of diminishing markets, success is blessing the efforts of the large housing

companies in the United States and they are now reaching a scale of operation where national marketing and the application of industrial processes begin to make economic sense. The integration or rationalization of the industry in Japan and its vision of housing as a consumer product, extending far beyond the buildng itself, will have an impact on these domestic companies. Franchising, after-sales follow-up, ventures into the renovation market, alliances with appliance or furniture companies, show parks downtown, custom design services, and increasing factory production of value-added components may all begin to emerge in some form but are not likely to be seen in as comprehensive a framework as we now see in Japan.

We may well see adoption of Japanese software before the hardware systems that are currently the lure of the housing expeditions to that country. It is in the area of management and organizational skills where early opportunities abound. Such opportunities could well open up new markets for domestic producers. They could replace falling starts in new residential construction with new profit centres that arise from this vision of housing that the Japanese have so carefully and meticulously cultivated.

Second, it is highly unlikely that the Japanese prefab housing companies will begin to unload housing parts or components at North American ports. North America is just not a likely market for their housing products in the foreseeable future. The prefab housing companies still have a great market potential within Japan and will agressively seek to increase their present market share, particularly in ther replacement market, much of which can be done with little additional capital investment in factories and machinery. On the other hand, that is not to say that they will not look elsewhere and capitalize on the perception of foreign consumers that has clearly become one of favouring Japan as better producers of quality goods.

Japan's immediate foreign market for the prefab housing industry could be East Asia and, in particular, the smaller East Asian states (which the Japanese call "little Japans") that are distinguished not by size but by their wealth. These include Singapore, Hong Kong, and Taiwan. Also, Korea and the prospect of a maturing China cannot be overlooked, and both India and Pakistan are longer term prospects.

Third, while we may not see the actual products of Japan's prefab housing companies arrive on our shores, we could well see the products of its research and development spending through licensing agreements with North American firms. Technological developments in Japan are increasingly being directed at two levels: daily living needs and specific industries. Japanese corporations expect to pioneer new products based around biotechnology, macroelectronics, and microcircuitry, and social innovation directed toward human needs as a top priority. The three areas considered to have the greatest social significance are in education, housing, and health and welfare.

In reversal of past roles Japan sees itself as a future exporter of technological innovation through sale of patent agreements, licensing agreements, and joint ventures with foreign firms. We may benefit, at a price, from some of MITI's current research, such as developing a prefabricated basement system, chemically treating wood for durability and fire resistance, or developing mechanical devices to accommodate the handicapped in the home. Japan now registers more than two and a half times the number of patents as the U.S. and eight times the rate of Britain. The seeds of Japan's technological future lie in these patent investments, and the prefab housing industry is well aware of this prospect.

The final point is an important but somewhat indirect revelation of the work to date. It could have a most significant impact on the North American housing industry, at least in the near future. If one combines the standard 2 x 4 wood-frame building system with the approach to the housing industry developed by the prefab housing companies, perhaps we have a glimpse of the future, at least in North America and possibly in foreign markets as well. It will likely take the actions of Mitsui and Mitsubishi to make us realize that we have in our possession a most sophisticated building system. We have simply lacked either the interest or the commitment and resources, both public and private, to develop and refine the capabilities and market potential of 2 x 4 construction overseas. That is not to demean the efforts of the lumber industry to increase foreign exports of wood, but it does point to the limitations of this approach, as compared to what one would expect from one of the great sogo-shasha or general trading companies of Japan.

Indeed, it would be ironic if Japan were to return to our shores with our own building system, thanks to a Mitsui or a Mitsubishi. This need not be the case, and, if it should ever come to fruition, it would signify not only lost opportunity at home but abdication of a responsibility to pursue the same foreign markets that Japan so eagerly awaits. The impending threat from the Japanese housing industry is not so much one of domestic competition but lost opportunity in an area in which North America has sustained domination since World War II, 2 x 4 wood frame construction. This implies the need for immediate action and a research agenda that can place our own industry at the same competitive edge.

As limited as this initial foray into Japanese industrialized housing has been, it has attempted to construct a general way of thinking about the future of the housing industry, perhaps more along the lines that a global competitor may wish to think.

BIBLIOGRAPHY

Business Intercommunications Incorporated. "Private Housing Supported by Loans of Housing Loan Corporation." White Paper of Japan, 1979. Tokyo, Japan, pp. 35-39.

Business Intercommunications Incorporated. White Paper on the Japanese Economy, 1979-83. Tokyo, Japan, pp. 35 (79), 32 (80), 41 (81), 31 (82), 72-79.

Business Week. "Home Buildings New Look". November 1983, pp. 92-99.

Business Week. "Japan: A High-Tech Prefab Opens Export Doors." 20 September 1982, p. 48.

CMR Associates. The Blue Book of Major Home Builders '83. Crofton, Maryland: CMR Associates, 1983.

Christopher, Robert C. The Japanese Mind. London: Pan Books Ltd., 1983.

Dietz, Albert G. H., and Cutler, Lawrence S., eds. Industrialized Building Systems for Housing. Cambridge: MIT Press, 1971.

Dluhosch, Eric. "The Japanese Approach to Industrialized Housing." Systems Building News. November 1971, pp. 40-45.

Economic Planning Agency. Economic Survey of Japan 1981-82. Tokyo, Japan: Japan Times Ltd., 1982, pp. 85-97, 180-82.

Economic Planning Agency. Economic Survey of Japan 1982-83. Tokyo, Japan: Japan Times Ltd., 1983, pp. 52-54, 121-31.

Eichler, Ned. The Merchant Builders. Cambridge: MIT Press, 1982.

Fraker, Susan. "The Prefabs are Beginning to Get it Together in the U.S. Too." Fortune. 17 October 1983, pp. 168-71.

Greenbawn, Mary. "Analysts Warm to Factory Built Housing." Fortune, 19 April 1982, p. 181.

Hakazora, Yoshihiko. "Japan Ranks Third in Research and Development Investment: Net Exporter of New Technology." Industrial Review of Japan 1984. Tokyo: The Japan Economic Journal, pp. 46-47.

Herbert, Gilbert. The Dream of the Factory-Made House. Cambridge: MIT Press, 1984.

Hofheinz, Roy Jr., and Calder, Kent E. East Asia Edge. New York: Basic Books, Inc., 1982.

Housing and Urban Development (HUD): "Custom-Built Assembly Line Homes Capture Japanese Market." Urban Innovations Abroad vol. 8, no. 2 (February 1984), pp. 1-3.

Fraker, Susan. "The Prefabs are Beginning to Get it Together in the U.S. Too." Fortune. 17 October 1983, pp. 168-71.

Greenbawn, Mary. "Analysts Warm to Factory Built Housing." Fortune, 19 April 1982, p. 181.

Hakazora, Yoshihiko. "Japan Ranks Third in Research and Development Investment: Net Exporter of New Technology." Industrial Review of Japan 1984. Tokyo: The Japan Economic Journal, pp. 46-47.

Herbert, Gilbert. The Dream of the Factory-Made House. Cambridge: MIT Press, 1984.

Hofheinz, Roy Jr., and Calder, Kent E. East Asia Edge. New York: Basic Books, Inc., 1982.

Housing and Urban Development (HUD): "Custom-Built Assembly Line Homes Capture Japanese Market." Urban Innovations Abroad vol. 8, no. 2 (February 1984), pp. 1-3.

Japan Institute of International Affairs. "National Life." White Papers of Japan - 1983. Tokyo: Economic Planning Agency, pp. 144-49.

Johnson, Chalmers. MITI and the Japanese Miracle. Stanford, California: Stanford University Press, 1982.

Matsuoka, Toshio. ed. Japan 1984, An International Comparison. Tokyo: Keizai Koho Center, 1984.

McMillan, Charles J. The Japanese Industrial System. New York: Walter de Gruyter, 1984.

Miami Herald. "Banzai - Japan's Home Builders Charge into U.S. Style Housing." Miami Herald, Sunday, January 30, 1983.

Mitsubishi Economic Research Institute (MERI). Monthly Circular. Tokyo, July 1976, August 1977, July 1980, July 1982, August 1982, September 1982, November 1982, December 1982, August 1983, November 1983, May 1984, July 1984.

New York Times. "Japan's International Trade and Industry Ministry." May 17, 1983, May 18, 1983.

Nutt-Powell, Thomas E. Manufactured Homes: Making Sense of a Housing Opportunity. Boston: Auburn House Publishing Co., 1982.

O.E.C.D. Unpublished Report Issued by the Housing Bureau, Ministry of Construction, Japan, 1984.

Oriental Economist. Japan Company Handbook. 1st Half-1984, Second Section Firms. Tokyo: Toyo Keizai Shinposha Ltd., 1984.

Partrick, H. and Rosovsky, H. eds. Asia's New Giant. Washington, D.C.: The Brookings Institute, 1976. Chapters 8 and 10.

Peck, Morton J., and Goto, Akiro. "Technology and Economic Growth: The Case of Japan." Research Policy. Vol. 10 (1981).

Reisehauer, Edwin O. The Japanese. Cambridge, Mass.: Beknap Press of Harvard University, 1977.

Saso, Mary, and Kirby, Stuart. Japanese Industrial Competition to 1990. Cambridge: AGF Books, EIV Special Series 1.

Smith, Lee. "How Japan Moves Ahead in Prefabs." Fortune, 17 October 1983, pp. 162-65.

Tsuneto Yano Memorial Society. eds. "National Livelihood." In Nippon: A Chartered Survey of Japan 1983-84. Tokyo: Kokusie-Sha, 1983.

Tsuneto Yano Memorial Society. eds. "National Livelihood." In Nippon: A Chartered Survey of Japan, 1982-83. Tokyo: Kokusei-Sha, 1982.

Tsuromi, Yoshi. Japanese Business: A Research Guide with Annotated Bibliography. New York: Praegar Publishers, 1978.

Vogel, Ezra F. Japan as Number One: Lessons for America. Cambridge: Harvard University press, 1979.

Yasuyuki Hippoh. The Construction Industry in Japan: A Survey. Tokyo, Japan: Asian Productivity Organization, 1983.

Yoshida, Y. ed. New Architecture: Industrialization of Housing. Tokyo, Japan: Shinkenchiku-Sha, 1984. (Special issue in Japanese only.)